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## EDITORIAL

No one without a sense of timing ever makes a success of treatment, a remark which applies as much to patients as to their doctors. For the patient with a chronic illness the calm ability to wait is a priceless asset; for the doctor, that capacity to sense the right moment for a change of policy is so often the biggest part of his task. To do the right thing at the wrong time is no better than to do the wrong thing at the right time. Cardinal de Retz, who had about as subtle a sense of timing as anybody has ever had, summed it up in his remark: "Everything in the world has its decisive moment; the crowning achievement of a good conduct of life is to know and pick out that moment." Nowhere is this more true than in therapeutics; and in no branch of therapeutics more than that which deals with diseases of the chest.

It is a good thing that timing should have been the subject of a surgeon's Presidential Address to the Tuberculosis Association this year. Thoracic surgery has had some fine advances to record this last twenty years; and we have come to a time when a decision upon surgical measures is far less often encumbered by technical distrust than it used to be. We are much more often in a position to regard surgery as perfectly feasible in the technical sense; but we are still far from being able to say that correct timing is as often so sure. It is right to say that technical difficulties of former times, and those which still remain, have been at the root of hesitancy and delay. But, admitting there are problems still unsolved in the technical field, there are many triumphs to record and over a very considerable part of thoracic disease suitable for surgical treatment such matters no longer offer serious obstructions. All the more, then, the choice of treatment becomes a matter for discussion not, as before, on technical feasibility but on the choice of time. The ground has shifted, the emphasis moved; and we ought to be quite clear in our own minds of the two distinct and separate viewpoints from which the feasibility of thoracic surgery should be regarded. Otherwise we are apt to be caught upholding the right course for the wrong reasons, or, what is worse, the wrong course for the wrong reasons.

There is no need here to go over the ground of Roberts' address. It is packed with examples, common for the most part, and all of them important, where false timing makes all the difference. But, of them all, his arguments for earlier thoracoplasty than is often the case strike a note we ought to heed with an attentive ear as a matter of such common occurrence. Here, if anywhere, is needed what Trotter called "long-range

guidance from rational contemplation and foresight." Roberts gives the arguments quite simply, and they look impressive when one realises that to neglect them may lead eventually to the surgeon being asked to do something equivalent to pulling a rabbit out of a hat—and do it without either hat or rabbit. One ought to go as far as this: that a method of treatment capable of good results when rightly used ought to be used when the chance of success is reasonable and better than any available alternative. That means, for thoracoplasty, as for everything else, a right choice of case and a right choice of time. We are liable to error with both decisions; but it ought to be easier to find agreement on the matter of time than it always is on the choice of case. We are not often too early with a thoracoplasty, but we are often too late. And on those occasions we are apt to think, a little ruefully, of Meredith's appropriate lines:

" Who can undo what time hath done,  
Who can win back the wind ?"

C. H.

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## GENERAL ARTICLES

“WHAT IS THE RIGHT TIME, PLEASE?”  
A SURGEON'S ANSWER

Presidential Address to the Tuberculosis Association, 1944.

By J. E. H. ROBERTS.

As one day I was walking along, turning over in my mind the choice of subjects for this address, a small boy stopped me and said: “What is the right time, please, mister?” You will notice that he was anxious to know not only the time but “the right time.” It struck me then that we might profitably consider what, from the point of view of the surgeon, is the right time for certain surgical interventions.

In the treatment of tuberculosis time, and a long time, has been in the past, and indeed is today, an essential element. But in many cases this time should be spent after and not before the surgical procedure has taken place. After all, the use of surgery in the treatment of pulmonary tuberculosis and of its complications is largely a recent growth. It is probably because of this that there is often little sense of urgency in considering the application of surgery in a particular case.

I am fortunate in the colleagues with whom I work in hospitals and sanatoria, and it has been interesting to me to note over a number of years their changing attitude to surgery and the earlier and earlier time at which the help of the surgeon is demanded. But still they can only deal with cases after they have arrived in their institutions, and I am afraid it is still true to say that quite a large part of my work is done too late.

When I was a house surgeon the number of late cases of perforated gastric and duodenal ulcers and of acute appendicitis was high. How different is the position today, though cases of intestinal obstruction still tend to be late, owing to the emphasis put on fæculent vomiting and abdominal distension in our surgical textbooks. In the tuberculosis world there is still a widespread tendency to regard surgical treatment as a last resource to be contemplated only when all other methods have failed. Now this attitude would undoubtedly be correct if the results of surgery applied at this late stage were satisfactory, but this is not so, and many patients who could have been restored to full wage-earning capacity are left as chronic wrecks or ultimately die.

The tuberculosis physician is always trying to get his cases at an earlier stage. When he succeeds in doing this, the results of his treatment are incomparably better than in the late cases, and he usually has no need for a surgeon. He must, then, not blame the surgeon for putting out his plea for earlier collaboration. In the pursuit of this aim I therefore propose to paint a somewhat gloomy picture of the type of case I have in mind.

I will begin, as all good doctors should, with the diagnosis. Here I would urge that where the tubercle bacillus has not been demonstrated, particularly

where hæmoptysis is present, the possibility of carcinoma of the bronchus or of bronchiectasis should be considered, and steps should be taken at once to make the diagnosis certain.

I see every year four or five cases of carcinoma in sanatoria often five or six months after the patient first came under observation. Carcinoma of the bronchus is today a curable disease at a certain stage, but the great majority of the patients are already inoperable when first seen by the surgeon. At the Hill End E.M.S. Hospital in my thoracic unit, I and Mr. Tubbs have had 127 cases in four years. Of these only thirty-five (27.7 per cent.) were operated on and only in eleven cases (8.8 per cent.) could pneumonectomy or lobectomy be performed. Eight of these eleven are still alive. Thus 91 per cent. were inoperable.

Mr. Brock has published very similar figures in which, of 187 cases, 92 per cent. were inoperable, and in 8 per cent. removal was possible. A delay of four to nine months before bronchoscopy is done and the diagnosis settled means as a rule that the patient has lost whatever chance he had.

Bronchiectasis is not so urgent, but it is surely undesirable to put a bronchiectatic patient in intimate contact with cases of tuberculosis.

I come now to the tuberculous cases.

#### CASES OF ARTIFICIAL PNEUMOTHORAX

Where adhesions are preventing efficient collapse of cavities there seems to be no good reason for delaying thoracoscopy for many months and sometimes several years. The risk of spread to the other lung and the higher incidence of tuberculous empyema are well known. Even when thoracoscopy has been done and the adhesions are found to be indivisible, there seems to be much hesitation in abandoning an inefficient pneumothorax and going on to some other form of collapse.

When sterile clear fluid forms in the pleura it may cease to form after a few or many aspirations; if it does not so disappear it tends to become opalescent, then turbid, and then frank pus. I do not know that there is any scientific definition of pus. How many cells to the cubic millimetre are necessary to distinguish turbid fluid from pus? In fact, if the fluid ceases to be clear because of the presence of cells there is no essential difference between opalescent, turbid and purulent fluids. While I am sure that the primary treatment should be repeated aspiration, perhaps accompanied by lavage, I am also sure that this process is carried on far too long in the majority of cases which do not respond to this treatment. The result is that a deposit forms on the parietal pleura which becomes thicker and thicker and more and more rigid, so that when at long last thoracoplasty is called for removal of the ribs does not allow the chest wall to fall in to obliterate the pleural space. That my experience of the type of case that is offered for operation is not unique is shown by the series related by Mr. Brock and others at the discussion on chronic tuberculous empyema in this room last year. I suggest, then, that when the fluid has ceased to be clear and is not clearing up after a proper trial of aspiration, it is unwise to wait until frank pus has formed and that, unless there is a very definite contraindication in the other lung, thoracoplasty should be done at that stage.

It is, I am sure, better as a rule not to drain a pure tuberculous empyema as a primary measure, but to do the thoracoplasty first. Some cases will then need drainage, possibly negative pressure suction drainage, before the cavity becomes obliterated.

The problem of the secondarily infected tuberculous empyema will, I hope, shortly cease to exist, as penicillin becomes available. The results so far are most encouraging.

The fate of the patient with an abandoned intra- or extra-pleural pneumothorax filled with tuberculous pus is at present the subject of conflicting views. It is undoubtedly established that some such patients may remain in apparent good health for years, but I know of no published series of cases in adequate numbers followed up for an adequate time. The tendency is to collect a number of cases known to have remained well without any indication of what proportion they bear to those who have come to disaster. My views, therefore, have necessarily to be based on the cases I see where perforation into the lung or through the chest wall or a spread of disease in the same or opposite lung has occurred, or in other cases a blood-borne secondary infection with pyogenic cocci has taken place. I and other surgeons see many of these cases. What proportion they bear to the ones who remain well is unknown, but the results when these things occur are so disastrous that until accurate figures are available we feel it would be better to submit such patients to thoracoplasty.

When repeated aspiration is done it is not uncommon, even with good technique, for inoculation of the tissues of the chest wall to occur. A little nodule forms and then a small sinus at the site of each needle puncture. These often appear to be quiescent and not of much consequence, but when incised at a later date a quite extensive collection of caseous pus is found at each site. This sometimes works back through the intercostal space and forms a secondary communication with the pleura. Quite extensive operations may be needed at the late stage, but if the small primary nodule is excised at once and the little wound left open it rapidly heals. The site for aspiration is still often not chosen with regard to the possibility of a subsequent thoracoplasty.

#### THORACOPLASTY

We still see a large number of cases in which all the indications for thoracoplasty have been present for several years. These are, of course, the survivors and because of their good resistance are often good surgical risks. One woman who had been a complete invalid for ten years and on whom her husband had spent all he had—£2,000!—was restored to health, doing her own housework. It was difficult to know what reply to make to the husband when he said: "But should this not have been done ten years ago?" So that not only the chance of the survival of the patient, but the economic point of view comes into question.

ONE TYPE of patient I see is the one with a small cavity at the apex who does well in the sanatorium and goes home physically well with no cough or sputum, but with the cavity still visible in the X-ray. Too often he returns with the cavity enlarged, new disease on the same side and often on the other side too; and yet a one-stage thoracoplasty of three or four ribs with

apicolysis would have made him reasonably safe with, in this class of case, very little risk.

At the King George V Sanatorium the use of tomographs has in recent years shown that many apparently closed cavities are still present.

A SECOND TYPE of case is where the patient after several months of bed rest is still febrile. Our experience has shown that usually, after the second stage of the thoracoplasty, the fever goes and the temperature remains normal. It would, I am sure, be wrong to operate on a febrile patient until adequate bed rest has been tried. But if the fever continues it is an indication and not a contraindication for operation.

A THIRD TYPE is where a massive collapse of a lobe has occurred as shown by the bowing over of the trachea. I did a lipiodol bronchogram on a large series of these patients and showed that they invariably developed bronchiectasis in the lobe. While they may at this stage be restored to comparative health by thoracoplasty they often remain with some sputum which contains tubercle bacilli. I therefore urge that thoracoplasty should be done as soon as the bowing over of the trachea is seen and before the development of the inevitable bronchiectasis has occurred. We have good evidence of extensive bronchiectasis occurring within two months of the collapse, so that the matter is one of some urgency.

A FOURTH TYPE is where there is some degree of bronchostenosis. As soon as an artificial pneumothorax is started a massive collapse of the lobe or the whole lung occurs. There is a great tendency for pleural effusion to occur and for the lung to remain collapsed. It is better, where adhesions are seen, not to divide the adhesions but to abandon the pneumothorax and perform thoracoplasty. I mention the cases with adhesions because these are the ones I see early, but if adhesions are not present I think the procedure should be the same.

#### COLD ABSCESS IN THE CHEST WALL. THE SO-CALLED TUBERCULOUS RIB OR CARTILAGE

In the majority of cases these abscesses start in lymphatic glands in the intercostal spaces. The abscess as it enlarges becomes adherent to the periosteum or perichondrium and the rib or cartilage is invaded from without by the tuberculous process. If operation is performed at an early stage the whole lesion, including a small section of the rib, can be cleanly excised without opening into tuberculous tissue. The wound then heals by first intention. Usually, however, as the patient feels no pain and the skin for a long time does not become red, the condition is treated by contemplation until such time as a sinus forms and the track becomes secondarily infected by pyogenic cocci. Even then, by a somewhat radical operation, all the infected tissue can be excised and healing obtained in the upper five ribs. Below this, however, the cartilages anastomose with each other, and new difficulties arise. Cartilage which is bare of perichondrium is quite unable to resist infection, so that the usual story is that a small cold abscess formed. As it was painless it was not regarded as being of importance. Eventually a sinus appeared and after some months an operation was done. The track was incised or excised and some infected cartilage was removed. The wound was sutured and healed.

After an interval another small sinus formed. Again, after a longer or shorter interval, usually longer, a second operation was done. This time a good deal more cartilage was found to be necrotic with caseous material running some distance along the cartilages. The process is then repeated until in some cases the whole of the cartilages have been removed. I am, you will remember, speaking of the many cases I have seen. The difficulty is to realise that a small sinus which causes little or no discomfort to the patient leads down to a constantly spreading hidden lesion. It is therefore of importance that these cases should be recognised early and that the lesion should be excised before a sinus has formed and secondary infection has become established. On no account should the abscess be incised and drained as is often done. The whole lesion should be cleanly excised and the wound sutured.

#### TUBERCULOUS EPIDIDYMITIS

Although in many sanatoria the testicles are examined as part of the general examination of a patient on admission, it is not, I find, a general custom to examine these parts again unless the patient draws attention to them. Now, tuberculosis of the epididymis is usually for a long time a painless condition. Even if the patient is aware of a small lump or has some discomfort, he very often says nothing about it, as the male sex is undoubtedly the modest sex in these matters. When, however, an abscess forms or a sinus appears, he tells the doctor about it. If the doctor is informed at the time when there is only a hard nodule to be discovered, he often takes an optimistic view of the prognosis and again treats the patient by contemplation. The result of all this is that by the time the surgeon sees the case he finds that not only is the condition in the scrotum advanced but the vesicula seminalis on that side is grossly enlarged, and there may be a lesion in the prostate as well. In my experience an early orchidectomy usually prevents the spread of the disease to the opposite testicle. Where the vesicle and prostate are infected, treatment by small doses of X-rays after orchidectomy is nearly always effective. I have watched a number of cases for as long as five years without recurrence. There is no difficulty in getting a patient's consent to a unilateral orchidectomy when it is explained that it is to save the opposite side, whereas a bilateral operation, especially in a young man, is sometimes followed by profound mental changes.

It is of course true that in some cases the tuberculous lesion as in all parts of the body may follow a benign course, but it is not the rule, and waiting to see if the case is a benign one leads often to disaster.

#### RENAL TUBERCULOSIS

The ordinary routine examination of the urine by a nurse does not reveal any changes in the earlier stages of renal tuberculosis. I may quote the case of a woman with pulmonary tuberculosis. One day I noticed on her chart that there was some increased frequency of micturition. The urine was said to have no abnormality, but when examined by a pathologist there was a slight trace of protein and a few pus cells and red cells in the centrifuged deposit. Some tubercle bacilli were also found. On cystoscopy a unilateral renal lesion was demonstrated. The condition is not common in sanatoria, but when it does occur it tends to be overlooked until late.

## ANAL FISTULÆ IN TUBERCULOUS PATIENTS

The perinæum, again, is a part of the body which is not as a rule submitted to regular routine examination. Unless the condition begins with a painful ischio-rectal abscess patients do not as a rule complain to the doctor. Many fistulæ are not painful, and there may be singularly little discomfort. When examined there may be only one small opening with very little discharge, so that, as operations on other parts of the body in patients with pulmonary lesions are not looked on with favour, nothing may be done about it. But all the time the hidden fistula is enlarging and tracking in various directions, so that in the end a very much larger operation is necessary than would have sufficed at an earlier date. Many of the fistulæ I operate on have been present from six months to a year or more. Now the operation on a rectal fistula causes no shock and I have never known the pulmonary condition to deteriorate as a result of such an operation.

The first time I operated on a fistula in a tuberculous patient the condition had been present for over six months. There were, I think, about fourteen openings in the skin. The case was one of bilateral pulmonary disease, which, as the patient had a constant evening temperature of  $100^{\circ}$  or over, was supposed to be too active to permit of operation on the perinæum. At last, however, the patient had so much pain that operation had to be done. From that day the patient's temperature became normal and, relieved of the toxæmia from the septic perinæum, the patient's pulmonary condition steadily improved.

The inference is that these conditions should be looked for without waiting for the patients to complain and when found be dealt with at an early stage.

Many of these fistulæ in tuberculous patients are not tuberculous, but when they are, provided that the tuberculous tissue is excised and not merely laid open, they heal as well as the non-tuberculous ones. The sooner they are operated on, then, the better chance there is of being able to excise all the tuberculous tissue.

The views I have been expressing are, I find, commonly held by thoracic surgeons both in this and other countries. We are in agreement that many cases are referred to us at much too late a date.

In the pulmonary and pleural cases (where we do not excise the diseased part) earlier surgical treatment leads on the whole to—

1. A saving of life.
2. A lowered incidence of later spreads and recurrences.
3. A shortening of the period during which the patient is capable of disseminating the disease to others.
4. A shortening of the period of invalidism and earlier restoration of the patient's capacity for work.

With pulmonary lesions there is, of course, a case for delaying surgical procedures, but I would ask you not to allow your successes when this is done to remain too prominently in your minds to the exclusion of the cases in which success is not achieved. The successful cases remain in view, the unsuccessful ones pass out of sight, and often out of mind. Accurate knowledge of their proportions is essential.

With the pleural lesions there is less of a case for delay. With the extra-thoracic lesions there is none at all. Here we are in the happy position of frequently being able to extirpate the whole lesion if the operation is performed at an early stage, or, to return to my opening words, "at the right time."

## CARBON DIOXIDE BY INHALATION IN THE MANAGEMENT OF COUGH

With Observations on its Effects upon Respiration in Pulmonary Tuberculosis.

By ANDREW L. BANYAI AND ANTHONY V. CADDEN,

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WHEN inflammatory products accumulate in the bronchial tract their removal is accomplished in two ways: (1) By coughing; (2) by resorption. Retention of infected exudate in the respiratory tract harbours serious consequences: (1) It may lead to complete obliteration of a bronchus and produce atelectasis; (2) it may cause a partial obstruction of a bronchus and by a check valve action may cause emphysema, or blocked cavities in tuberculosis; (3) it may induce an intracanalicular spread of the disease. Fantus<sup>1</sup> aptly said that cough is in most instances an important means of effecting drainage from the bronchi. "Stop the cough and the micro-organism-laden discharge, instead of being expectorated and thereby rendered harmless, stagnates and becomes more and more poisonous and damaging to the bronchial wall. Indeed, the lumen of bronchioles may become stopped up with secretion—and this is more likely to happen in the tiny bronchioles of small children—the tributary lung lobules undergo atelectasis from absorption of the air within, and this may be followed by extension of the inflammation into them; thus a case of bronchitis may be converted into bronchopneumonia."

Excessive cough, on the other hand, interferes with the patient's rest and with rest for the lungs; also it may cause the spread of disease from one part of the lung to the other or from one lung to the other. Archibald and Brown<sup>2</sup> demonstrated by roentgenographic studies that iodised oil injected into the tracheobronchial tract may be carried into the finer bronchioles and the alveoli by the increased inspiratory rush of air which precedes or follows cough, or by the intense expiratory effort if the proximal connecting bronchus is partially blocked. Lord<sup>3</sup> emphasised the potential danger of severe cough under certain circumstances: with an impaired myocardium, cough caused by an acute respiratory infection or passive congestion may even overtax an already burdened heart and become a contributory cause of heart failure. Our experience in pulmonary tuberculosis taught us that strenuous, protracted cough may accelerate the development of tuberculous laryngitis, emphysema, and spontaneous pneumothorax, may lead to pulmonary hæmorrhage or cause a dislodgment of a thrombus following pulmonary hæmorrhage and thereby lead to recurrent bleedings. Excessive cough may also cause vomiting, loss

of appetite, exhaustion, headache, insomnia, rise in temperature, marked dyspnoea, cyanosis, thoracic pain, subconjunctival hæmorrhage, or urinary incontinence.

Additional dangers of excessive cough mentioned by Hatcher<sup>4</sup> are: cerebral hæmorrhage in hypertension; the rupture of a lung abscess; tearing of a sutured lung from the wall of the chest after an operation for pulmonary suppuration; the fracture of a rib, the tearing of sutures after an abdominal operation, causing hernia; maintaining a tuberculous process in an active state by exertion and heightened pressure in the thorax; and dissemination of infected material outside the body, with the spread of the disease to others.

Reviewing the many sources of cough, pulmonary as well as extrapulmonary, it is evident that its adequate management involves a knowledge of its origin and the type and amount of sputum. Our purpose here is to call attention to a hitherto infrequently used expectorant, the clinical value of which has been ascertained empirically and has pharmacological support.

We have used carbon dioxide by inhalation as an expectorant in pulmonary tuberculosis for the past thirteen years and have found that it is most efficient. It changes an excessive yet unproductive cough into a useful cough and thereby often helps to eliminate sometimes the dangers inherent in an accumulation, retention, and insufficient expectoration of inflammatory products. We found that carbon dioxide liquefies the mucopurulent exudate in the bronchi and reduces its viscosity so that sputum becomes thinner, more serous and watery; furthermore, the sputum is loosened up and consequently is expectorated without strain or effort. We have noted that following inhalations the amount of expectorated sputum is greater than before the treatment, and also that adequate evacuation of the bronchi ensures for the patient comparatively long periods of rest free from annoying cough.

In a thorough clinical investigation Basch, Holinger and Poncher<sup>5</sup> studied the effectiveness of the commonly used expectorants, cough sedatives, and of carbon dioxide. They found that ammonium chloride, potassium iodide, fluid extract of senega, fluid extract of ipecacuanha and emetine hydrochloride have the common property of lowering the viscosity of bronchial secretions. At the same time, the amount of ash was influenced only insignificantly by these expectorants. Also it was noted that the content of total nitrogen of the sputum was regularly and markedly higher after the administration of ammonium chloride, was increased to a lesser degree after the administration of saponins, was only occasionally higher after the use of ipecacuanha and was fairly regularly increased after the use of emetine hydrochloride; potassium iodide showed no consistent change in this respect. The dried residue was found to be increased only after the administration of ammonium chloride. Furthermore, these studies revealed that codeine sulphate increased the viscosity and dried residue of sputum and its influence was progressively greater the longer the drug was used. A comparison of these observations with the results obtained by the inhalation of carbon dioxide showed that the latter acts as a real expectorant by diluting the sputum; by lowering its viscosity and reducing all of the examined solid contents; the liquefaction of the sputum was greater by the inhalation of carbon dioxide than by the administration of expectorant drugs.

### Methods

The apparatus used in our work consists of a tank, containing a mixture of 10 per cent. carbon dioxide and 90 per cent. oxygen, mounted on a small platform on casters that makes it possible to give the inhalations to bed patients. An oxymeter regulates the flow of gas per minute. Originally we worked with an ordinary mask used for general anaesthesia; more recently the B.L.B. mask has been used. The inhaler is connected to the tank by rubber tubing. A rubber bag which serves as a small reservoir is attached to the inhaler. In some patients it was found expedient to give the inhalations through a glass tube instead of the mask, either because they were reluctant to accept the mask, or the respiratory stimulation was too strong from closed inhalation of the mixture. It is fully realised that, when inhalations are administered through a glass tube held in the patient's mouth, admixture of air and dilution of carbon dioxide take place; but results by this so-called open method are quite satisfactory. The open method is recommended for patients who are markedly debilitated or who show some of the possible side-effects when the closed inhaler is used. It is a good policy to explain to the patient briefly the mode of action of the inhaled gas, the expected changes in respiration, and the probable subjective symptoms. Inhalations by the closed method are given by a nurse. After proper instructions, inhalations through a glass tube can be administered without constant supervision; however, it is the responsibility of the nurse to regulate the flow of the gas and time of the treatment. As a rule, the meter is set to 4 to 5 litres per minute for closed inhalations and to 5 to 7 litres per minute for the open method. The length of each treatment varies from five to fifteen minutes, and the inhalations are administered once, twice, or three times a day. It is necessary to observe the patient closely during the first treatment. If it is noted that the respirations become too strenuous, the inhalations should be given with brief (one-minute) interruptions. In rare instances, when the closed method is used, it may be necessary to reduce the flow to less than 4 litres per minute. In the beginning, the treatments are given daily; subsequently, the frequency of inhalations can be reduced, depending upon the relief obtained. Some patients are obliged to take them daily for an extended period of time, while in others the interval between inhalations can be increased to a week or ten days.

### Results

We conducted an investigation as to the effect of therapeutically administered carbon dioxide inhalation on the respiration in pulmonary tuberculosis. Ten of the forty patients studied took the treatments by the closed method, the others by the open method. Altogether 275 observations were analysed. The anticipated response to the inhalation of 4 to 6 litres of carbon dioxide-oxygen per minute by the closed method was an increase in the respiratory rate. But we found this in three instances only. The respiratory rate remained unchanged in three and decreased in nine observations. This is at variance with findings in normal persons and can be explained (1) by the reinflation of previously atelectatic areas of the lung with a consequent immediate relief from dyspnoea and (2) by an increase in amplitude rather than in rate of

respiration. In two instances the rate dropped in four minutes from 26 to 14 and from 24 to 10, respectively. In two patients an initial decrease in rate was followed by a moderate increase toward the end of treatment.

With the open method the pattern of respiratory response was similar to that found with the closed method. Of the 258 observations with the open method, 4 litres of the gas mixture per minute were given in 8 instances; 4.5 in 9; 5 in 181; 5.5 in 3; 6 in 9; 6.5 in 9; and 7 in 39. At the end of the inhalations the number of respirations was increased in 89 instances. The increase varied from less than 10 to 60 per cent. of the initial rate; the great majority of this group showed a rise less than 30 per cent. In 93 instances the number of respirations was decreased; the reduction varied from less than 10 to 42.6 per cent.; it was less than 20 per cent. in 79 instances. The initial rate varied between 16 and 40 per minute, with the majority between 20 and 29 per minute. There was a group of observations in which during the inhalation of carbon dioxide the respiratory rate first decreased and then increased; in another group an opposite response was recorded. Where the rate at the end of the observation period was the same as the original rate, there was an intermediate decrease in 27, or 35.5 per cent., and an intermediate rise in 15, or 19.7 per cent. In the group with a final reduction in the respiratory rate an intermediate increase was noted in 31, or 33.3 per cent. Where the final respiratory rate was elevated, an intermediate decrease was seen in 6, or 6.7 per cent. The intermediate increase varied from less than 10 to 60 per cent. of the initial rate, the great majority showing a rise between 10 and 29 per cent. The intermediate decrease varied from less than 10 to 42.6 per cent. of the initial rate, the great majority falling between 6 and 19 per cent. It is interesting to note that the final respiratory rate was the same as the initial rate in 76 instances, or 29.5 per cent., and it was less than the initial rate in 93, or 36 per cent. Altogether, the final rate remained unchanged or was reduced in 169 instances, or 65.5 per cent., as against 89 instances, or 34.5 per cent., in which the respiratory rate was increased at the end of the inhalation of the gas mixture.

Our favourable clinical results with carbon dioxide as an expectorant are in harmony with the reports of other investigators who have used it in various pulmonary conditions. Good results were seen from its use by Henderson and his associates,<sup>6</sup> MacKenzie,<sup>7</sup> and Scott and Cutler<sup>8</sup> in the prevention and treatment of post-operative atelectasis. Alison<sup>9</sup> observed a response to carbon dioxide inhalations in acute bronchitis of infants and children. Symptomatic relief was seen in bronchial asthma by Tiefensee,<sup>10</sup> Hurst,<sup>11</sup> and Campbell and Poulton.<sup>12</sup> Henderson<sup>13</sup> recommended it for allaying the spasmodic phase of whooping-cough. Gratifying symptomatic improvement was recorded in broncho-pneumonia and pneumonia in children by Gruenberg and Viethen<sup>14</sup> and by Alison.<sup>9</sup> Unresolved pneumonia was treated by carbon dioxide inhalations by Christie.<sup>15</sup> Churchill<sup>16</sup> used the Henderson inhaler for the administration of carbon dioxide for aiding the re-expansion of the lung in patients who were operated on for empyema.

Since 1930, when we began the administration of carbon dioxide to tuberculous patients, we have been using it for the following indications: (1) Strenuous, exhaustive cough without effective expectoration if there is

evidence of inflammatory exudation in the lungs; when the cough is insufficient to evacuate sticky, thick sputum and thereby causes gagging, vomiting or incontinence, or when the sleep or rest of the patient is disturbed by coughing. (2) Dyspnoea originating from lobular atelectasis due to bronchial obstruction caused by pre-ulcerative or ulcerative tuberculosis of the bronchial wall or by viscid mucopurulent plugs. (3) Dyspnoea originating from massive atelectasis. (4) Presence of large cavities with insufficient drainage through the connecting bronchus. (5) Bronchiectasis secondary to pulmonary fibrosis associated with the healing of the tuberculous process when postural drainage is impracticable or is not effective for evacuating the stagnating secretions from the dilated bronchi. (6) For aiding expectoration in cases of retention of inflammatory products following phrenic nerve block or during the course of artificial pneumothorax. (7) Cough which is not strenuous but is insufficient to remove accumulated material from the lungs.

According to our experience, practically all patients tolerate carbon dioxide inhalations well, provided the amount of the inhaled gas and the timing of inhalations are individually adapted to the patient's requirements. In some of our patients we noted some transient minor side-effects of these inhalations, such as hot sensations, palpitation, weakness, frontal headache, and slight dizziness. None of these symptoms interfered with the treatment when proper adjustments were made in the method of administration.

### Conclusions

1. The administration of a mixture of 10 per cent. carbon dioxide and 90 per cent. oxygen by inhalation is a safe and feasible procedure.
2. Analytical studies and clinical experience of others, as well as our own personal observations during the past thirteen years, show that carbon dioxide by inhalation is an efficient expectorant.
3. Its liquefying effect upon mucus in the bronchial tract is greater than that of the commonly used expectorants.
4. Carbon dioxide by inhalation occupies a unique place among expectorants in that—besides its liquefying action—it is capable of stimulating the respiratory centre. Stimulation of the respiratory centre causes increased respiratory expansions of the thorax, a consequent stretching and dilatation of the bronchi, and an increase in the bronchial peristalsis. These factors contribute substantially to the effective mechanical elimination of inflammatory products from the respiratory tract.

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## MASS MINIATURE RADIOGRAPHY IN THE ROYAL AIR FORCE

A Report on 250,027 Consecutive Examinations of R.A.F. and W.A.A.F. Personnel.

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### HISTORY OF MASS MINIATURE RADIOGRAPHY IN THE ROYAL AIR FORCE

THE Royal Navy had already started miniature radiography before the R.A.F. could put a unit in operation. It was not until 1941 that the first machine, a gift of the British Red Cross, was available. By the autumn, after a preliminary test on 3,000 films on a mobile unit, a start was made on entrants for air crew at a main receiving centre.

Although at that time this unit was established on a static basis, the necessity for using mobile units to widen the scope of the examination and include as many R.A.F. personnel as possible was already envisaged.

The guiding principle of the scheme from its inauguration was that it should have clinical and not purely radiological units—that is, each unit had observation beds and all facilities for physical and bacteriological examination on the same station, the whole being under the immediate control of the officer in charge of the unit. He, in turn, was responsible to an officer in charge of the whole scheme, which was controlled by, and extended through, a central headquarters with direct contact with the Director-General and the Consultant in Medicine.

Shortly afterwards, five mobile units arrived from the United States, and by July 1942 all six machines were in operation at receiving centres scattered throughout England. The first mobile subsection commenced work in July 1942, visiting numerous R.A.F. stations and examining their personnel. The remaining four mobile units were located at various R.A.F. recruit centres and operated on a static basis for some while, as the large amount of work to be done then precluded the diversion of any unit to a mobile basis. Later another unit was diverted and operated as a mobile subsection during the summers of 1943 and 1944. It reverted to a static basis during the winter months of 1943. Although the machines differed in construction and output (see Part I) all six operated with 35 mm. film and all could take large films. In other words, it was possible to follow up any miniature film showing

abnormal shadows by a complete investigation similar to that of the out-patient and in-patient routine of any well-run chest hospital. Just as no final diagnosis or disposal was allowed on abnormal shadows alone, no single observation was allowed to prejudice the continuance or stoppage of training in any individual case, as a system of observation for entrants showing anomalous or doubtful findings was instituted; it was possible to arrange out-patient observation and re-examination up to three or six months.

By this means, and by central control for criteria on diagnosis and the sharing of observations as between individual units, it was possible from the first to organise a complete system of records under files compiled on a classification of diseases and abnormalities, ranging from bony abnormalities to such established diagnoses as phthisis and new growth.

By the time that the Medical Research Committee on Tuberculosis in War-time, under the chairmanship of Lord Dawson, had furnished its report, results were published. (i) The officer i/c Chest Radiography for the R.A.F. served as a member of this committee, and of a following committee, set up at the request of the Minister of Health, to advise on the preparation of a scheme of mass radiography for the general population. In these committees' reports use was made of further results of the R.A.F. investigation. (ii) The clinical approach to the whole problem set out by the second report is much on the same lines as the R.A.F. scheme—*e.g.*, it recommends that the director of the unit should be a clinician and that he should be given facilities for the clinical examination of every case found to have abnormal film shadows.

Up to date some 500,000 entrants to the Service, R.A.F. and W.A.A.F. personnel, have been examined. It is now possible to publish the results of 250,000 who had been examined by July 1943 and followed up where necessary to September 30, 1943.

### PART I.—ORGANISATION

**APPARATUS IN USE.**—Three types of mass radiography apparatus are in use in the Royal Air Force: (a) Solus, (b) Westinghouse, and (c) Watson.

All three produce a frame approximately 1 inch square on 35 mm. film. They can also be used for taking 15 × 12 inch or 17 × 14 inch radiographs.

(a) *Solus*.—The Solus unit was presented to the R.A.F. by the British Red Cross. It was the first apparatus used and was employed for the original experimental work. Subsequently it was installed at the first chest radiography subsection.

The apparatus consists of a 230-volt, single-phase four-valve transformer unit with a Dynamax Model D rotating anode tube, the large focus (4.2 mm.) only being used. The tunnel-camera unit consisted of a light-proof wooden tunnel with a Levy West type of fluorescent screen backed by lead glass on the camera side. The special hand-operated camera, designed by Newman, had an F. 1.5 Xenon lens set at 36 inches from the screen.

This apparatus produced satisfactory results, but after 75,000 exposures it was found that the moving parts of the camera were becoming worn and the tunnel camera unit has been temporarily replaced with one of the type adapted for use with the Westinghouse apparatus (see sub-paragraph b).

The control unit now in use embodies separate Kvp. and milliamperage controls for radiography and screening. A Kv. meter indicated the Kvp. selected, but the milliamperage is pre-set by means of the filament current control. A dial range milliammeter and a milliamperage-seconds meter are fitted and give accurate indications of the tube consumption.

Exposure-time control is variable between 0.1 second and 8 seconds in 10 stages for radiography, and a detachable foot switch is provided for screening purposes. The control system is electrically interlocked with the camera and card circuits.

The exposure factors with the original combination were 100 ma., 80 to 90 Kvp. at 0.25 to 0.5 second. With the present type of tunnel-camera unit they are 100 ma., 76 to 80 Kvp. at 0.15 to 0.4 second.

(b) *Westinghouse*.—The Westinghouse equipment was presented to the R.A.F. by the American Red Cross.

Each set was installed in a van equipped as a travelling X-ray unit. The vans were provided with a petrol-driven generator set capable of delivering 3,000 watts at 115 volts A.C. and was fully automatic in operation. At first the apparatus was removed from the vans and used for static subsections, but recently it has been found advantageous to employ mobile subsections and two of the sets have been replaced in their vans.

A set consists of a Westinghouse  $\frac{1}{2}$  mfd. condenser discharge unit fed from a two-valve rectifier. A Machlett Aeromax D focus tube is used in each case.

The sets are of two types. The Junior supplies up to 90 Kvp. and the B type up to 100 Kvp. The B type can also be used for screening with a pulsating supply.

The control units also differ slightly, but in each type the Kvp. is controlled in stages of 10 and 2 throughout the range of 30 to 90 Kvp. and 30 to 100 Kvp. respectively, a Kvp. meter indicating the valve selected. A charging meter operating on the milliammeter principle is fitted. The B unit also has a filament ammeter and choke control for screening purposes. Both types are provided with line voltmeters and provision is made to correct for different line voltages within certain limits. Exposure time is pre-set in each case and is not under the control of the operator, while the milliamperage-seconds available are, in each case, one-half of the indicated Kvp. using  $\frac{1}{2}$  mfd. capacity. The B unit can also be operated on  $\frac{1}{4}$  mfd. giving milliamperage-seconds of one-quarter of the indicated Kvp.

The tunnel-camera unit consists of a light-tight metal tunnel with a Patterson B type fluorescent screen backed by lead glass. A special Kodak camera, designed by Kodak in conjunction with R.A.F. technicians, is employed. The lens is of F. 1.5 focal factor and is set at 36 inches from the screen. The camera is reset by hand after each exposure, but there is an electrical interlocking device which prevents a second exposure being made until the film has been moved on one frame. The details of the construction of the cameras vary slightly, but basically the designs are very similar.

The exposure settings used vary from 75 to 95 Kvp.

(c) *Watson*.—This apparatus, designed by Watsons following recommendations by the M.R.C. Sub-Committee on "Tuberculosis in War Time," is loaned to the R.A.F. by the Ministry of Health. The set consists of a Machlett

Dynamax, Model D, rotating anode tube excited by a four-valve rectifier unit. The tunnel-camera unit consists of a light-tight metal tunnel with a Levy West yellow-green fluorescent screen backed by lead glass. A grid is fitted in front of the screen. The camera is one specially designed by Watson and is completely automatic in operation. The lens is of F. 1.5 focal factor.

The control unit provides Kvp. control from 50 to 100 in 20 steps. Exposure time is variable from 0.01 to 1 second and a milliammeter and a self-resetting milliampere-second meter are provided. The tube current may be adjusted from 100 to 400 milliamperes in 4 stages, and the circuit is so arranged that the maximum tube rating cannot be exceeded. The set may be run from supplies of 140 to 250 volts, single phase; appropriate connections are simply made by means of a hand knob on the control panel. A removable foot switch is provided for screening. Exposure factors used are 200 ma., 75 to 85 Kvp. at 0.15 to 0.2 second.

**CARD ILLUMINATOR.**—All types of apparatus are fitted with card illuminator devices. When the exposure is made the patient's identification number, printed on a card bearing his name, is photographed alongside the miniature radiograph. Provision is made in each case for adjusting the brilliance of the card lamps, and electrical interlocking devices prevent the operation of the set if the card is not in position, or is improperly inserted, and also if the card illuminator lamps become defective.

**TUBE STANDS.**—In all types the tunnel and X-ray tube are capable of vertical movement to suit the height of the patient. The tubes are mechanically coupled to the tunnel, so that the tube is always properly aligned with the screen.

**FILM USED.**—35 mm. photo fluographic film is used in all cameras. Kodak Flurodak has been used for the majority of the examinations, although Ilford CX, HPX and other types of film have also been employed. The miniature radiographs are approximately 1 inch square and are magnified by projection for viewing.

Experience has shown that no one type of film is perfectly satisfactory in all respects. The size of the grain, speed of film and degree of latitude vary considerably with different films, and many experimental exposures have been necessary to discover the types of film most suitable to the various combinations of tube, screen and lens. Any one film rarely combines the three essential qualities previously mentioned to a marked degree, and in the maintenance of satisfactory results so far it has been necessary to combine carefully the exposure technique and dark-room work.

#### ORGANISATION OF SUBSECTIONS

There are two types of Chest Radiography Subsection in the Royal Air Force—static subsections and mobile subsections. The static subsections are those whose apparatus is set up in a building on a permanent or semi-permanent basis. Mobile subsections are provided with two motor-driven vans, one of which is a travelling X-ray room and the other a dark room.

(a) **STATIC SUBSECTIONS.**—The advantages of a static subsection are that a large number of examinations—up to a peak of 2,000 miniature radiographs per week—can be performed and that the work is completely independent of

the weather. In addition it is possible to arrange for an adequate and steady main electric power supply for the X-ray apparatus.

For the best work the accommodation must be adequate. A room approximately 20 by 20 feet in size is necessary for a dressing-room, and the X-ray room should not be smaller than 250 square feet. Where large numbers are dealt with it is essential that these two rooms shall be on the ground floor in order to maintain a one-way system of traffic. The X-ray room and dressing-room should lead directly out of each other through two doorways. In addition to these two rooms space must be found for a dark room, drying-room for films, store room, projector room, office and medical officer's room.

The majority of subsections have been set up in requisitioned premises such as blocks of flats, small hotels or large private houses, so that adequate space has been available. On permanent camps it has been found necessary to adapt two standard barrack huts, connecting them by a corridor.

Static subsections are established at stations where there is a constant change of personnel. Such units as recruit receiving depots, or training schools where there are a number of short courses, are suitable. The aim is to deal with a turnover of 1,000 to 1,500 miniature radiographs per week.

(b) **MOBILE SUBSECTIONS.**—Mobile subsections are used for dealing with a group of stations, the moving population at any one of them being insufficient to justify the provision of a static subsection. One of the stations is selected as a base. The base should be in a place where there is a constant, if small, moving population, and where there is a hospital or other similar accommodation for the admission of observation cases. At the base station the mobile subsection is allocated a store room and offices for the medical officer and his clerks. The X-ray room, dark room and drying-room are replaced by two mobile vans, and the rest of the accommodation, which is similar to that of a static subsection, is occupied as a temporary measure whenever mass radiography takes place either at the base or at another station.

One of the mobile vans contains a complete Westinghouse type of mass radiography apparatus, which derives its electric power from the generator on the van or by plugging in to any convenient electric power point. The advantages of the condenser discharge apparatus are its comparative portability and the fact that it can work from almost any power point (a low-powered lead only resulting in the condensers taking longer to charge). The normal method of working is from an electric supply point; the generator is only used when such a supply is not available. The disadvantages of the generator is that it causes vibration of the van.

The second van is completely equipped as a dark room, and similarly can be worked from a generator or by plugging into an electric point. In addition arrangements are made by which each van can be supplied with electricity from the generator of its fellow. The dark-room van has all the necessary apparatus for processing and drying 35 mm. and 15×12 inch X-ray films. It also carries supplies of chemicals, films and other medical equipment. It is essential, when a subsection is visiting a station other than its base, that it shall be absolutely self-sufficient if work is to be satisfactory. However, owing to the difficulty of carrying sufficient water on a van for washing films, it is customary to make use of a hose running from a conveniently placed

tap to the dark-room van, or to wash films in an existing dark room or bathroom.

It has been found that existing dark rooms on stations are usually not sufficiently light-proof for use when processing photofluographic film, which is exceedingly sensitive. Consequently all processing takes place in the mobile dark-room van.

When taking miniature films two alternative methods of working can be employed. The X-ray van can be parked outside a hut selected for use as a dressing-room, and the individuals for examination strip to the waist, put on their tunics and pass in single file to the X-ray van and back to the hut. A mobile corridor is provided to be placed between the hut and X-ray van; this gives privacy and protects from rain. Alternatively, the van can be placed in a hangar or other closed accommodation, dressing-room accommodation being improvised. This method gives better protection from the weather, but, owing to the danger of fumes from the generator in an enclosed space, the electric power has to be derived from an electric point or from the generator of the dark-room van, which is parked in the open. This produces difficulties owing to the dark-room and X-ray vans being separated.

It is obvious that the working of a mobile subsection is not so simple or easy as that of a static subsection. Consequently the number of miniature film examinations is smaller. Six to nine hundred per week is aimed at, although occasionally larger numbers can be dealt with.

#### STAFF AND TRAINING OF PERSONNEL

The Chest Radiography Subsections are all organised on a similar basis and are under the technical control of a headquarters section. The officer in charge at headquarters is responsible for the organisation of the subsections, training of staff, checking of results, compilation of records and statistics and for arrangements for the servicing of apparatus. A number of electrical technicians on the staff are employed solely on maintenance and repair; this is most important work, for breakdowns may cause considerable disorganisation of the work of the subsection.

The staff of a subsection consists of the following:

(a) A medical officer in charge, who is responsible for the interpretation of miniature and full-size radiographs, clinical examinations and other investigations required to arrive at a diagnosis of the abnormalities discovered.

(b) A radiographer, who is normally the N.C.O. in charge. He takes all radiographs and supervises the remainder of the staff under the direction of the medical officer in charge.

(c) A nursing orderly, who is responsible for assisting the medical officer and is usually able to act as a relief radiographer.

(d) Two photographers, whose duties consist of work in the dark room and assistance in the X-ray room by positioning the patients.

(e) Two clerks, who complete the record cards, the numbers on which are photographed on to the miniature films at the time the radiograph is taken. The clerks are also responsible for all necessary clerical work of the subsection.

(f) Two aircraft hands, who are employed as marshallers for patients in the dressing-room, as assistants to photographers and clerks, and as runners.

Although each member of the staff is employed primarily for a specific duty, it is essential that all shall have some knowledge of the duties of the others so as to be able to render assistance when required.

The medical officers in charge of subsections have been trained by the officer in charge of chest radiography. They were originally selected for their knowledge of chest diseases, a sound clinical knowledge being considered most important. The training consisted of instruction in the interpretation of miniature and full-size films and in the clinical and pathological investigations used in the diagnosis of chest conditions. Thus an attempt was made to ensure that the work would be carried out on a uniform basis.

The remainder of the staff of the first subsection to be established were trained by the officer in charge of chest radiography and the senior specialist in radiology at the time that the first experimental work was undertaken. The staffs of the other subsections were trained at an existing subsection. This training consisted of instruction in the technique for taking and processing of miniature and full-size chest films, and in the administrative and clinical procedure to be employed.

#### PROTECTION OF X-RAY ROOM STAFF

At a Chest Radiography Subsection the number of exposures per day may reach a total of 400. The quantity of X-rays generated consequently exceeds that usually encountered in an X-ray department, and with this fact in mind it was considered essential that adequate precautions should be taken to ensure that the staff are not exposed to a harmful amount of radiation.

Arrangements are made whereby both the radiographer and the individual positioning the patients are standing behind the protective screens at the moment of exposure. It has been found that a camera which is cocked by hand, and not automatically, is a useful adjunct in this respect, for if the camera is cocked by the positioner, after placing the patient in position, and a protective screen is placed so that a person standing beside the camera is protected from the tube, it is difficult for the positioner to disregard these safety precautions.

The wearing of protective aprons is insisted upon for all staff present in the X-ray room. It has been found that aprons impregnated with barium paste which hang down over both the anterior and posterior surfaces of the body are more comfortable to wear than the usual lead aprons which cover the anterior surface only.

The further precaution is adopted of carrying a piece of dental film in the pocket of the working dress. This is developed after one week; blackening of the film indicates some exposure to radiation. Unfortunately, such a method of estimating exposure is somewhat crude as no real quantitative estimation can be made in this way.

A check is kept on the blood counts of all the staff of a subsection. The minimum standard accepted for an individual before commencing work is 4,000,000 red cells, 80 per cent. hæmoglobin, 6,000 white cells, 2,000 polymorphs and 1,500 lymphocytes. Individuals working in the X-ray room have blood counts monthly and the remainder of the staff six-monthly, in order to check any possibility of X-ray damage.

As no case of injury due to exposure to X-rays has occurred, it appears that the precautions have been adequate. Exposed dental films show that some individuals are prone to be careless, and it has been found necessary to check the technique at intervals in order to ensure that instructions are being obeyed.

Blood-count results are subject to considerable individual variations, and it cannot be stated that any very striking points have emerged. Some individuals known to have been careless in the X-ray room have shown a slight persistent fall in the white-cell count, especially lymphocytes, but never to levels sufficient to cause anxiety. It has been the practice to remove such individuals from X-ray room work for a period of a few weeks with opportunity to get plenty of fresh air and exercise, when the white-cell count has again risen.

The impression obtained is that, with the precautions outlined above, X-rays have little or no effect on the blood count and that any fall is due as much to long hours of indoor work as to any one other factor. Falls in the white-cell count have occurred as frequently in individuals not normally employed in the X-ray room as in those known to be prone to carelessness in the X-ray room. In both the count returned to its previous level after a short holiday.

#### ORGANISATION

**CLINICAL POLICY.**—All entrants to the R.A.F. and W.A.A.F. have had the usual National Board examination before call-up. This may have taken place some months before joining the Service. Among them certain sections of the R.A.F. personnel are subjected to a further strict physical examination on entry as they are volunteers for special duties. It follows that those with physical signs, symptoms, and many with family history of chest disease will have been weeded out at these preliminary examinations. Therefore most of these special entrants, who form about half of the R.A.F. personnel under review, came into the category of the presumably healthy at the time of first attendance at a Chest Radiography Subsection.

It is no stigma on the practitioners carrying out these preliminary examinations that they do not detect disease in the chest which is first suspected by miniature radiography.

The scheme of operation for a Chest Radiography Subsection is to use radiography and clinical means as a method of separating the normal from the abnormal in several stages. First, all those individuals whose miniature films are not assessed as normal when projected for viewing by the officer in charge are separated from the remainder. They usually number from 2 to 5 per cent. of those originally examined, and the individuals concerned are recalled for the taking of a full-size film of the chest. These large films are then read while wet, when it is found that approximately one-half are normal and require no further action. This decision is checked when the films are dry. The individuals showing an abnormal large film are then subjected to a complete clinical investigation—that is, history taking, physical examination, and such pathological investigations as blood sedimentation rate and sputum examination as may appear appropriate. A further separation is again made. Those individuals whose abnormalities are judged to be of no clinical importance are returned to duty. The remainder are continued under observation, either as

out-patients or in sick quarters, until such time as a diagnosis and decision as to their disposal can be made.

This stage of final diagnosis and disposal can usually be reached by the officer in charge of the subsection. Cases of difficulty are normally referred to the officer in charge chest radiography at headquarters. Where the investigations required—for instance, bronchoscopy—are beyond the facilities available locally, transfer to a hospital is arranged.

In certain cases final diagnosis can be made at the stage of out-patient investigation; others require a period of observation as in-patients for both ultimate diagnosis and disposal (*e.g.*, active or inactive tuberculosis as a final diagnosis and transfer to sanatorium or tuberculosis officer as disposal after invaliding).

There remains a further group in whom the lesion at first complete examination is either anomalous (*e.g.*, query pneumonia, query tuberculous) or, while definitely tuberculous, is of small extent and apparently inactive but at a dangerous age group. Such individuals are placed under observation in accordance with King's Regulations. They have stamped on their medical documents the following:

"It is recommended that this individual be placed under observation, be recategorised temporarily to Grade III for ..... months, be excused guards, marching and P.T., and be re-examined by a medical specialist or at a Chest Radiography Subsection in ..... weeks, when a report of the clinical findings and an X-ray film of the chest should be forwarded to Chest Radiography Section, Headquarters, Central Medical Establishment, for decision. The X-ray film will be returned after inspection."

By this means it is possible by serial X-rays and full clinical reports to arrive at an opinion on diagnosis and disposal. Usually by the expiration of this period of observation the underlying pathology will be more easily assessed by changes in the film, or in the physical signs, or in both.

Patients with non-tuberculous abnormalities are usually returned to full duty, having received appropriate treatment. Many cases of pneumonia, atypical pneumonia and bronchopneumonia fall into this group.

Tuberculous cases can be divided into active and inactive disease. Cases of active tuberculosis are almost invariably invalided and referred to the appropriate authorities for continuance of treatment. Inactive cases, however, present a different problem. The factors which must be considered are the interests of the individual and the interests of the Service. Age, experience, length of service, and special qualifications must be taken into account. With these facts in mind the risk of a breakdown occurring under Service conditions must be assessed and a decision made as to retention, placing in a lower medical category, or invaliding. In untrained individuals radiological evidence of disease affecting more than one zone of the lungs is usually considered grounds for invaliding, but cases have to be dealt with on their individual merits.

**SYSTEM OF RECORDS.**—The system of records depends on a card bearing a serial identification number. It is this number which is photographed alongside the individual's miniature radiograph.

The card is first made out by a clerk, who records the Service number, rank, name, age and unit, at the time of attendance for miniature radiography. It is used for recording the results of the miniature films and of our subsequent large films and can take notes of clinical investigations, diagnosis and final disposal. In order to produce some uniformity a table has been prepared covering all possible diagnoses. To each diagnosis a classification of diseases number has been allotted; the appropriate number is entered on the card when final diagnosis is made.

The above briefly covers the system of records used. In addition each subsection maintains a day book and is responsible for notifying parent units of the necessity for further attendance of personnel for large film examination. The Senior Medical Officer of the parent station is informed of the result of the examination so that it can be recorded on the patient's medical documents.

Upon completion at a subsection all record cards, miniature films and large films are forwarded to the headquarters section. Here all large films and cards are re-examined and checked against each other to ensure that no error has occurred. Should the officer in charge query the diagnosis or consider that further investigations are required the subsection is so informed. It is not practicable to re-examine all miniature films at headquarters, so a sample check only is performed.

Before filing cards and films at the headquarters section, various statistical procedures such as age-grouping are performed, so that the headquarters section has full information concerning the work done.

## PART II.—CLINICAL RESULTS

AGE GROUPS INVOLVED.—190,076 males and 59,951 females are included in the results reported. They fall into age groups as follows:

TABLE I.—AGE DISTRIBUTION OF EXAMINATIONS REPORTED.

<i>Age :</i>			17-19.	20-24.	25-29.	30-34.	35-39.	40-44.	45 and over.
Males	..	..	80,994	50,923	18,445	17,379	15,198	5,979	1,158
Females	..	..	21,780	31,154	4,452	1,497	662	341	65

The males were all serving airmen of the Royal Air Force. With comparatively few exceptions they were all individuals who had joined or been called up during the present war. Consequently they had practically all been examined by a National Service Medical Board before examination by mass radiography. The few who had not had such a board had been medically examined and passed fit before acceptance by the R.A.F.

Precise information is not available as to the length of time that had elapsed between the National Service Board and mass radiography examination, but it must have averaged between three and twelve months.

In addition, amongst the age groups under 30, approximately one-half

of the men had, within the previous six months, had a much stricter medical examination with a view to selection for special duties.

It will be noted that the majority of individuals fall into the age groups 17 to 24; thereafter the numbers fall considerably, and after age 44 the numbers are so small as to make any deductions from the results obtained likely to be unreliable.

The females were all serving airwomen in the W.A.A.F. All had been medically examined by a National Service Board prior to being called up, the time interval between the Board and examination by mass radiography averaging six months. In the age groups 17 to 24 the numbers are such that it is permissible to draw deductions from the results obtained. The age group 25 to 29 is not nearly so reliable, and after the age of 30 deductions are likely to be misleading owing to the small numbers.

**INCIDENCE OF TUBERCULOSIS.**—It must be emphasised that the results reported do not depend solely on radiological findings. In all cases the clinical side of the case has been taken into consideration before arriving at a diagnosis.

(1) *Sputum-Positive Cases.*—Of the cases considered to be active pulmonary tuberculosis a number are known to have a positive sputum. In the majority of cases the result was obtained by the examination of three smears, using the Ziehl-Neelsen method of staining. No doubt a larger number of sputum-positive cases would have been discovered if more elaborate methods of examination had been used, and it is probable that a proportion of cases regarded as sputum-negative were later proved to be positive, although this information did not reach the appropriate Chest Radiography Sub-section.

The incidence of sputum-positive pulmonary tuberculosis was as follows:

TABLE II.—INCIDENCE OF SPUTUM-POSITIVE TUBERCULOSIS.

*Figures in Parenthesis are Percentages of Numbers Examined.*

Age :	17-19.	20-24.	25-29.	30-34.	35-39.	40-44.	45 and over.
Males ..	50 (0.07%)	28 (0.06%)	18 (0.10%)	10 (0.06%)	17 (0.11%)	7 (0.11%)	0
Females ..	15 (0.07%)	18 (0.06%)	5 (0.11%)	0	0	0	0

Total: Males—130 (0.07%). Females—48 (0.08%).

(2) *Incidence of Post-Primary Pulmonary Tuberculosis.*—The incidence of pulmonary tuberculosis, considered to be active, including sputum-positive cases and those cases considered to be inactive, is shown in Table III (see opposite page).

It will be noted that approximately between 20 and 25 per cent. of the cases diagnosed as active tuberculosis proved to have a positive sputum, even to three smear examinations only.

TABLE III.—INCIDENCE OF POST-PRIMARY PULMONARY TUBERCULOSIS.

Age :	17-19.	20-24.	25-29.	30-34.	35-39.	40-44.	45 and over.
<b>MALES:</b>							
Active ..	203 (0·25%)	158 (0·31%)	43 (0·23%)	46 (0·26%)	53 (0·35%)	26 (0·44%)	5 (0·43%)
Inactive ..	194 (0·24%)	168 (0·33%)	128 (0·69%)	167 (0·96%)	183 (1·21%)	88 (1·48%)	18 (1·56%)
Total ..	397 (0·49%)	326 (0·64%)	171 (0·92%)	213 (1·22%)	236 (1·56%)	114 (1·92%)	23 (1·99%)
<b>FEMALES:</b>							
Active ..	74 (0·34%)	130 (0·41%)	15 (0·33%)	2 (0·13%)	2 (0·30%)	1 (0·29%)	0
Inactive ..	79 (0·36%)	160 (0·51%)	50 (1·12%)	22 (1·48%)	11 (1·66%)	13 (3·80%)	0
Total ..	153 (0·70%)	190 (0·92%)	65 (1·45%)	24 (1·61%)	13 (1·96%)	14 (4·09%)	0

TOTALS: Males—Active, 534 (0·28%); Inactive, 946 (0·49%); Total, 1,480 (0·77%).  
Females—Active, 224 (0·36%); Inactive, 345 (0·58%); Total, 569 (0·94%).

(3) *Active Tuberculosis*.—The younger age groups are those which are usually considered of special importance; the figures show that in both sexes the highest incidence falls in the age group 20 to 24 for those individuals under 30 years of age. The incidence in females is higher than in males in approximately the ratio 4 : 3.

The older age groups, however, produce an interesting finding. Far from showing a diminished incidence of active disease, the figures for males show an increase in the age groups 30 to 34 and 35 to 39, which from the numbers examined is probably a true finding. This increase continues in the age group 40 to 44, and although here the comparatively small total numbers examined make the figures less reliable there is no doubt about the upward trend.

The number of females over the age of 24 is comparatively small and the incidence of active disease in the older age groups shown by the present figures cannot carry much weight, but it is interesting to note that the comparatively lower incidence in the late twenties as against that for the age group 17 to 24 found in the males has a parallel in the figures for females, and the higher incidence after 34 appears to occur in both sexes.

It appears therefore that active tuberculosis occurs more frequently in young women than young men, and that in males at any rate there are two specially dangerous periods—the age group 20 to 24 and after the age of 34.

(4) *Inactive Tuberculosis*.—It may be allowed as a general statement, although admittedly not strictly correct, that a lung which has been affected by a post-primary tuberculous infection will thereafter show radiological evidence of the disease. On this basis some interesting points can be made from the figures for inactive tuberculosis. It will be noted that the incidence increases

steadily with the age of the individuals in both sexes, and that the increase is most rapid after the age group 20 to 24. The steady increase throughout the period of life under review is due to the fact that a greater number of individuals are being infected as time goes by, and the rapid increase in the incidence of inactive tuberculosis between the early and late twenties can be correlated with the high incidence of active disease in the age group 20 to 24. Further, the fact that the incidence of inactive tuberculosis continues to increase steadily up to at any rate the age group 40 to 44 is additional evidence that fresh active cases, and not merely reactivations of previous inactive cases, are occurring in the thirties, for if there was a lower incidence of fresh active disease at this period of life one would expect the rate of increase of inactive disease to be less. It is considered therefore that the figures for inactive tuberculosis tend to support the findings for active tuberculosis.

(5) *Comparison with Notifications.*—It is interesting to compare the findings reported here with figures for the Notification of Respiratory Pulmonary Tuberculosis and the Crude Death Rate from Pulmonary Tuberculosis for England and Wales for the year 1938. These are based on information kindly supplied by Dr. Norman Smith of the Ministry of Health.

TABLE IV.—NOTIFICATIONS AND DEATHS (1938) FOR PULMONARY TUBERCULOSIS.

(Figures based on information kindly supplied by Dr. Norman Smith.)

Age :	15-19.	20-24.	25-34.	35-44.	Totals.
<b>MALES—Notifications, 1938:</b>					
Total notifications .. .. .	2,208	2,915	5,272	4,460	14,855
Rate per 1,000 .. .. .	1.26	1.89	1.58	1.57	1.57
<b>Deaths, 1938:</b>					
Total deaths .. .. .	620	1,154	2,551	2,473	6,798
Crude death rate per million .. .. .	353	740	766	870	718
<b>FEMALES—Notifications, 1938:</b>					
Total notifications .. .. .	2,819	3,525	5,308	2,664	14,296
Rate per 1,000 .. .. .	1.64	2.26	1.52	0.84	1.43
<b>Deaths, 1938:</b>					
Total deaths .. .. .	1,065	1,499	2,600	1,498	6,662
Crude death rate per million .. .. .	619	962	746	470	668

It will be noted that the increased incidence of active tuberculosis in the age group 20 to 24 found by mass radiography is reflected in a rise in the notification rate, but that the increase in the later age groups is not. It seems therefore that a large number of cases of active tuberculosis over the age of 30 are not diagnosed, or if diagnosed are not notified. They are probably of importance as a source of infection for the younger individuals.

(6) *Observation Cases.*—It has not always been possible to arrive at a diagnosis of active or inactive tuberculosis at the time that a suspicious case was first discovered. In such an event the practice has been to place the case under observation for a period of two or three months, which period was, where necessary, extended up to six or more months until it was felt that a

diagnosis could be made. Such cases have been placed on light duty and periodically recalled for X-ray and clinical examination.

There are in fact a number of such cases of the examinees under review who have not yet completed the period of observation considered necessary. Their numbers are as follows:

TABLE V.—CASES STILL UNDER OBSERVATION.

Age :	17-19.	20-24.	25-29.	30-34.	35-39.	40-44.	45 and over.
Males ..	36 (0.04%)	18 (0.03%)	16 (0.09%)	9 (0.05%)	6 (0.03%)	2 (0.03%)	0
Females ..	16 (0.07%)	39 (0.13%)	5 (0.11%)	1 (0.07%)	0	0	0

TOTAL: Males—87 (0.04%). Females—61 (0.10%).

The total number of cases placed under observation after their first complete examination, clinical and radiological, was 283 males and 158 females. Those who have completed their period of observation have been included under the heading of the final diagnosis. The results of the observation cases are as follows:

TABLE VI.—RESULTS OF OBSERVATION CASES.

## MALES:

Total placed under observation	..	..	..	..	283	
Still under observation	..	..	..	..	87	
Period of observation completed	..	..	..	..	196	
Finally diagnosed as—						
Active tuberculosis	..	..	..	..	27	(13%)
Pleural effusion	..	..	..	..	1	(0.5%)
Inactive tuberculosis	..	..	..	..	147	(75%)
Atypical pneumonia	..	..	..	..	15	(7.6%)
Pulmonary fibrosis	..	..	..	..	5	(2.6%)
Nil abnormal discovered	..	..	..	..	1	(0.5%)

## FEMALES:

Total placed under observation	..	..	..	..	158	
Still under observation	..	..	..	..	61	
Period of observation completed	..	..	..	..	97	
Finally diagnosed as—						
Active tuberculosis	..	..	..	..	15	(15.4%)
Inactive tuberculosis	..	..	..	..	68	(70%)
Atypical pneumonia	..	..	..	..	8	(8.2%)
Pulmonary fibrosis	..	..	..	..	6	(6.1%)

It will be noted that the majority of cases ultimately prove to be inactive tuberculosis. A number are finally diagnosed as active and a small proportion prove to be non-tuberculous abnormalities.

(7) *Incidence of Inactive Primary Tuberculosis.*—Under the heading inactive primary tuberculosis are included the cases showing a calcified focus in the lung fields, thought to be a Ghon's focus, with or without evidence of calcified

tracheo-bronchial or hilar glands, and calcified glands alone. The incidence was as follows:

TABLE VII.—INCIDENCE OF INACTIVE PRIMARY TUBERCULOSIS.

Age :	17-19.	20-24.	25-29.	30-34.	35-39.	40-44.	45 and over.
<b>MALES:</b>							
Calcified nodules only	199 (0.25%)	154 (0.30%)	65 (0.35%)	94 (0.54%)	107 (0.71%)	52 (0.87%)	17 (1.48%)
Calcified glands only	139 (0.17%)	118 (0.23%)	44 (0.24%)	49 (0.28%)	41 (0.27%)	28 (0.47%)	4 (0.35%)
Nodules and glands ..	161 (0.20%)	106 (0.21%)	50 (0.26%)	67 (0.39%)	59 (0.39%)	39 (0.65%)	10 (0.87%)
Calcified glands with and without nodules	300 (0.37%)	224 (0.44%)	94 (0.50%)	116 (0.67%)	100 (0.66%)	67 (1.12%)	14 (1.22%)
<b>FEMALES:</b>							
Calcified nodules ..	108 (0.49%)	120 (0.38%)	22 (0.49%)	9 (0.61%)	7 (1.05%)	6 (1.76%)	1 (1.53%)
Calcified glands only	34 (0.15%)	45 (0.14%)	4 (0.09%)	5 (0.35%)	0	2 (0.58%)	0
Nodules and glands ..	45 (0.20%)	60 (0.19%)	19 (0.42%)	3 (0.20%)	3 (0.45%)	3 (0.88%)	2 (3.7%)
Calcified glands with and without nodules	79 (0.36%)	105 (0.34%)	23 (0.52%)	8 (0.53%)	3 (0.45%)	5 (1.48%)	2 (3.7%)

Total Inactive Primary Tuberculosis: Males, 1,603 (0.84%). Females, 498 (0.83%).

As primary tuberculosis is usually regarded as being essentially a disease of childhood one might expect that the incidence of calcification resulting from it would not alter appreciably in the different age groups of adult life. It will be seen, however, that generally speaking it rises as one progresses from the younger to the older age groups. In the case of calcified nodules in the lung fields without calcified glands, this might be due to errors in diagnosis—that is, some of the lesions thought to be Ghon's foci might have been in reality the result of post-primary lesions. However, a similar rise also occurs in the incidence of calcified glands, both alone and when occurring with a calcified nodule. In the case of females the numbers are insufficient to warrant drawing deductions from this fact, but for males the numbers up to the age group 35 to 39 are considered adequate.

This rising incidence of evidence of a "childhood type" of lesion can be explained in two ways. It may be that the incidence of childhood tuberculosis was more prevalent thirty to forty years ago than it was seventeen to thirty years ago, and consequently a larger percentage of the older age groups now show evidence of its results. An alternative explanation is that this type of lesion occurs in older individuals more frequently than is generally thought.

(8) *Pleural Effusion*.—Pleural effusion of the predominantly lymphocytic type occurred 24 times—17 in males and 7 in females. Amongst the males 11 were on the left side and amongst females 5 on the left side. The age distribution was as follows:

TABLE VIII.—INCIDENCE OF LYMPHOCYTIC PLEURAL EFFUSION.

Age:			17-19.	20-24.	25-29.	30-34.	35-39.	40-44.	45 and over.
Males ..	..	..	7	8	0	1	1	0	0
Females	..	..	2	4	0	0	1	0	0

In 6 cases—5 males and 1 female—there was an encysted pleural effusion, which investigation suggested was of tuberculous origin.

**NON-TUBERCULOUS PULMONARY LESIONS.**—The finding next in importance to pulmonary tuberculosis has been that of the non-tuberculous pulmonary lesions, including atypical pneumonias, pulmonary fibrosis and pleural thickening.

(i) *Atypical Pneumonia.*—The term atypical pneumonia can be applied to lesions which radiologically resemble pneumonia or bronchopneumonia, but which differ in their ætiology and clinical course. It is probably true that there are several types of this condition, but mass radiography, by its mode of operation, has had its attention focused almost solely on one particular type. The type referred to is that in the patient who is found to have a partial pneumonic or bronchopneumonic lesion without usually presenting enough constitutional disturbance to make him report sick. Clinically the majority of these patients merely complain of a "cold in the head" and a slight cough. A few presented constitutional disturbances in the form of malaise and fever, and were admitted to sick quarters, but the majority were ambulant. There did not seem to be any relation between the extent of lung involvement and constitutional symptoms. Radiologically the lesions were of a partial pneumonic or bronchopneumonic type, maximal within a day or two of the onset of symptoms of a nasal coryza, and fading within two or three weeks, to leave localised bronchitic or drainage type shadows slower of resolution. Resolution of the pneumonic or bronchopneumonic lesions was delayed in a few cases for as long as five or six weeks; these cases often showed continued nasal infection in the form of pansinusitis.

The site of the lesions was predominantly basal or in the mid-zones, although a few upper zone lesions were encountered. This latter type presented some difficulty in differential diagnosis, especially if resolution was delayed.

The ætiology of the condition has not yet been elucidated. It is possible, however, that it is a virus infection of the whole respiratory tract, producing acute coryza and permitting invasion of the lower respiratory tract by descending infection. Time and circumstances have not permitted the carrying out of agglutination tests. Examination of the upper respiratory tract has shown evidence of coryza or sinus infection in the majority of cases.

In males 327 cases of atypical pneumonia have been discovered (0.17 per cent.), 132 being predominantly pneumonic in type, and 195 predominantly bronchopneumonic. In females there were 39 cases (0.065 per cent.)—19 pneumonic and 20 bronchopneumonic.

The distribution in age groups is given in the table.

TABLE IX.—DISTRIBUTION BY AGE GROUPS OF THE RADIOLOGICAL TYPES OF ATYPICAL PNEUMONIA.

Age :	17-19.	20-24.	25-29.	30-34.	35-39.	40-44.	45 and over.
<b>PNEUMONIC TYPE:</b>							
Males .. ..	68 (0·08%)	28 (0·05%)	14 (0·07%)	9 (0·05%)	8 (0·05%)	5 (0·08%)	0
Females .. ..	7 (0·03%)	9 (0·03%)	2 (0·04%)	1 (0·07%)	0	0	0
<b>BRONCHOPNEUMONIC TYPE:</b>							
Males .. ..	99 (0·12%)	50 (0·10%)	15 (0·08%)	15 (0·09%)	9 (0·06%)	6 (0·11%)	1 (0·08%)
Females .. ..	9 (0·04%)	7 (0·02%)	4 (0·09%)	0	0	0	0

It therefore appears that atypical pneumonia may affect individuals at all ages, and, having regard to the numbers examined in each age group, the figures do not show evidence of particularly high incidence at any period of life.

There was, however, a fairly marked seasonal variation in the incidence, as may be seen from the following tables showing the results from one subsection in the south of England and from one in the north of England.

TABLE X.—INCIDENCE OF ATYPICAL PNEUMONIA AS DISCOVERED BY SECTIONS IN THE NORTH AND SOUTH OF ENGLAND.

	South.			North.		
	Number Examined.	Atypical Pneumonia.	Per Cent.	Number Examined.	Atypical Pneumonia.	Per Cent.
1942:						
January .. ..	1,926	3	0·16	—	—	—
February .. ..	4,546	8	0·18	420	2	0·48
March .. ..	4,686	11	0·24	4,312	6	0·14
April .. ..	5,567	8	0·14	3,533	6	0·17
May .. ..	2,320	0	0	3,581	7	0·20
June .. ..	3,302	2	0·06	4,371	4	0·09
July .. ..	7,078	7	0·10	4,623	0	0
August .. ..	3,614	2	0·05	6,907	9	0·13
September ..	3,972	6	0·15	6,079	3	0·05
October .. ..	4,467	4	0·09	4,962	8	0·16
November ..	3,164	5	0·16	2,886	7	0·24
December ..	1,796	6	0·34	2,666	7	0·26
1943:						
January .. ..	2,056	5	0·24	824	5	0·61
February .. ..	3,074	7	0·23	650	0	0

The number of individuals examined in some months is so small as to make detailed conclusions of little value. It seems evident, however, that the incidence of atypical pneumonia varies with the time of year and climatic conditions, and that variations do not necessarily run parallel in different parts of the country.

(ii) *Pulmonary Fibrosis.*

TABLE XI.—SHOWING INCIDENCE AND DISTRIBUTION OF PULMONARY FIBROSIS.

	<i>Right Upper Zone.</i>	<i>Right Middle Zone.</i>	<i>Right Lower Zone.</i>	<i>Left Upper Zone.</i>	<i>Left Middle Zone.</i>	<i>Left Lower Zone.</i>	<i>Bi- lateral.</i>	<i>Total.</i>	<i>Incidence.</i>
Males ..	17	14	59	4	4	36	15	149	0.078%
Females ..	5	5	7	4	6	6	3	36	0.060%

Pulmonary fibrosis, considered to be of non-tuberculous origin, showed a fairly equal incidence in the two sexes. The distribution of the fibrosis, however, showed that in males the condition was relatively more common in the lower zones, especially the left lower zone. Although in the majority of cases a history of pneumonia was obtained, no previous history of chest complaints could be ascertained in others.

(iii) *Pleural Effusion (Non-tuberculous).*—One male and 1 female.

In both of these cases, the effusion was of pneumococcal origin, as evidenced by the history, clinical and pathological findings. The condition was in neither case quiescent, as both cases ran a slight pyrexia after their removal to hospital, and showed a predominantly polymorphonuclear leucocytosis.

(iv) *Interlobar Effusions.*—Males—3; females—0.

The 3 cases of interlobar effusion which have been encountered were limited to the lower part of the greater fissure. Evidence suggests that in all cases the condition was a consequence of a limited infection arising in or near a fissure, and not through local encystment of a general effusion. The condition has proved to be of slow absorption, 2 cases still being under observation. In 1 case there was found to be a chronic pansinusitis.

(v) *Thickened Pleura.*—Thickened pleura has been conveniently divided into three main types: (a) Simple obliteration of one or other costophrenic angle. (b) Thickened interlobar septum. (c) Thickened parietal pleura.

Minor degrees of "tenting of the diaphragm" have not been included in this series.

The incidence of these various types is given in the table below.

TABLE XII.—INCIDENCE OF THICKENED PLEURA.

<i>Type.</i>	<i>Right.</i>	<i>Left.</i>	<i>Bilateral.</i>	
<b>MALES:</b>				
Obliterated costophrenic angle .. ..	294	309	22	= 625
Thickened interlobar septum .. ..	35	27	0	= 62
Thickened parietal pleura .. ..	16	19	1	= 36
				723 (0.38%)
<b>FEMALES:</b>				
Obliterated costophrenic angle .. ..	18	23	1	= 42
Thickened interlobar septum .. ..	4	4	0	= 8
Thickened parietal pleura .. ..	1	1	0	= 2
				52 (0.086%)

Of all types obliteration of the costophrenic angles is by far the commonest, comprising 86 per cent. of all types in males and 81 per cent. in females. The explanation for this finding undoubtedly lies in the prevalence of pneumonic lesions, including empyemata, in childhood. Although the majority of patients did give a history of such an occurrence in the earlier years of life, many denied any such illness. The figures show a very slightly higher incidence on the left side in both sexes.

"Thickened interlobar septum, often visible on the postero-anterior film as "tenting of the diaphragm," is most commonly seen in the lower part of the greater fissure. It is decidedly less common than obliterated costophrenic angle, but is presumably due to the same causes. The figures for men show, in contradistinction to the other types, a greater incidence on the right side, but this may be due to the fact that there are two main fissures on the right side, against one on the left side.

Thickening of the parietal pleura was less common than either of the two preceding types, and in this series the patients nearly always gave a history of pneumonia with pleurisy during the preceding ten years. As with the other types, it was found to be nearly always basal.

It may be conveniently mentioned at this point that several cases were encountered in which there was a history of pneumonia and empyema followed by rib resection, but whose radiograph showed no abnormality whatever apart from the regenerated rib segment. The converse is also true, that some cases of extensively thickened pleura give no history of preceding chest malady.

(vi) *Bronchiectasis*.—Eighty-six cases were discovered, 79 (0.042 per cent.) in males and 7 (0.012 per cent.) in females. In the majority of cases the diagnosis has been made on radiological and clinical evidence. Bronchography has not been a routine procedure, as patients have rarely presented marked symptoms, and, in our opinion, the investigation is undesirable if signs and symptoms are absent, as it may form the starting point for a neurosis.

The majority of cases have been basal and bilateral disease is most frequently found. Physical signs in the chest have been present in most cases, but were rarely marked. Finger clubbing was infrequent, although it is probable that few cases were of long standing or showed an acutely progressive disease. Inflammatory lesions of the upper respiratory tract were a common associated finding.

(vii) *Bronchiolitis*.—In 4 male cases and 1 female case X-ray showed innumerable hard miliary nodules evenly scattered throughout both lung fields. No enlargement of the bronchial or hilar glands nor evidence pointing to a diagnosis of Boeck's sarcoidosis were discovered. Clinically the patients denied all symptoms and there were no abnormal signs beyond an occasional sibilus. It was considered that these 5 cases represented a type of bronchiolitis obliterans.

(viii) *Pulmonary Abscess*.—Two cases were detected in males, none were found in female personnel.

The 2 cases discovered were of great clinical interest because in some respects they required differential diagnosis from pulmonary tuberculosis; they were differentiated by their complete clearance in under two months and the failure to demonstrate the tubercle bacillus at any stage of the disease. Both

abscesses were small in size, and were situated in the right upper zone. The condition was symptomless apart from a slight cough with occasional sputum. The blood count showed a slight polymorphonuclear leucocytosis in the early stages, but soon reverted to normal.

Both abscesses resolved completely with rest alone.

**PNEUMOKONIOSIS.**—The incidence of pneumokoniosis in this series has not been high owing to the predominance of the lower age groups. A total of 12 cases have been discovered. Most of the patients have fallen into the 30 to 34 age group, and give a history of from five to ten years' work at their various trades—namely, coal workers 8, stone masons 2, builders' worker 1, and hæmatite iron ore worker 1. The cases have been typical of the condition, with the exception of the builder's worker, in whom the method of production of the lung lesions has been obscure. In all but 2 cases the radiological appearances were those of reticulation or nodulation. In the 2 cases in question, coalescent nodulation, or massive shadows, were present, and in 1 there was a concurrent tuberculous infection.

**TUMOURS.**—Under this heading 18 cases are included here. Of the 14 male cases, 3 are of bronchial adenoma, 3 dermoid cysts, 1 neurofibroma, 1 bronchial carcinoma, 1 lymphatic leukæmia and 5 lymphadenoma. Of the 4 female cases, 2 are chondroma of the lung, 1 neurofibroma and 1 lymphadenoma.

The bronchial adenomata presented as cases of pulmonary collapse. Operative removal was successfully undertaken in all cases, and the patients eventually returned to duty.

The case of carcinoma of the left lower bronchus also presented the signs of collapse of a lung segment.

The man with lymphatic leukæmia showed marked bilateral mediastinal glandular enlargement, with small glands palpable elsewhere. The blood picture was typical, and in spite of deep X-ray therapy a fatal conclusion occurred in two months.

Of the 2 cases with chondroma of the lung, one was confirmed at operation. The other was not proved as the patient refused the necessary investigations.

**ACQUIRED CARDIOVASCULAR LESIONS.**—In 24 cases this type of lesion was found.

Mitral disease was diagnosed in 6 males and 7 females, and aortic disease due to rheumatism in 2 males and 1 female. Cardiac changes associated with hypertension occurred in 6 cases (3 men and 3 women). In one man there was marked atheroma and in another an adherent pericardium.

It will be noted that the number of abnormalities discovered is comparatively small. It must be remembered, however, that all personnel had previously been submitted to a clinical examination before examination by mass radiography, and that in consequence the majority of cardiovascular lesions are likely to have been discovered and the individual not accepted for service.

**THYROID GLAND ABNORMALITIES.**—Four cases were discovered in female and 2 in male personnel.

The presence of a substernal goitre or adenoma was responsible for the

detection of these cases. In none was there obvious thyroid enlargement in the neck, but a few of the cases presented symptoms of obstruction at the superior thoracic inlet, this being successfully relieved by surgical intervention.

**MULTIPLE OSTEOMATA.**—Six cases in all were discovered—5 in males and 1 in female personnel.

This condition is included, as its discovery on the ribs by mass radiography was, as far as the examiners know, the first indication that the patient presented the abnormality. An investigation disclosed the presence of other osteomata on the inner condyle of the femur, tibia and humerus in addition to those present on the ribs and clavicles.

**PLEURAL CYSTS.**—Pleural cysts were discovered in 13 cases—11 in males and 2 in females. The cysts were discovered by noting on the miniature films an abnormal shadow in the right cardiophrenic angle.

**CYSTIC DISEASE.**—Congenital cysts of the lung were found more frequently in men (28 cases, 0.014 per cent.) than in women (5 cases, 0.0083 per cent.). Of the various types, multilocular cysts occupying the whole of one lobe of the lung proved to be the commonest type (19 male and 3 female cases). Solitary cysts were detected in 9 males and 2 females and were nearly always found in the right lung, adjacent to the hilum; they were often of a large size, reaching in several cases to the periphery. In 1 case the cyst contained fluid.

Two cases of particular interest were discovered. In one there was multilocular cystic disease of the left upper lobe with a congenital absence of the lower lobe. In the other case the cyst occupied the whole of the lobe, and a rudimentary bronchus was also present. Operation for removal was successful.

**LARGE EMPHYSEMATOUS BULLÆ.**—Seven cases of large emphysematous bullæ were noted, all in men. The majority were encountered in the lower zones, often in association with basal fibrosis.

**SPONTANEOUS PNEUMOTHORAX.**—In this series pneumothorax, considered to be of non-tuberculous origin, was encountered in 5 cases, all in men. Careful radiography enabled bullæ to be detected at the periphery of the upper lobe in 2 cases. It is notable that all cases were symptomless and that re-expansion occurred quickly without incident.

#### CONGENITAL ABNORMALITIES OF THE CHEST

**INCIDENCE OF CONGENITAL ABNORMALITIES OF CHEST.**—Developmental abnormalities of the thoracic structures are common findings on miniature films. It must be pointed out at the onset that these findings are purely incidental to the examination of the lung fields, and that it is highly probable that certain abnormalities—*e.g.*, cervical rib—would have been discovered in greater number had the radiographic technique been directed towards this end.

In Table XIII. will be found the results obtained in the miniature radiographic examination of 190,076 males and 59,951 females. No attempt has been made to enumerate all the variations and types of abnormalities, but only the general classes are given.

TABLE XIII.—CONGENITAL ABNORMALITIES.

Abnormality.	190,076 Men.		59,951 Women.	
	Number.	Per Cent. (approx.)	Number.	Per Cent. (approx.)
Unilateral cervical rib ..	60 (58%)	0.055	103 (55%)	0.31
Bilateral cervical rib ..	44 (42%)		83 (45%)	
Unilateral abnormal first rib ..	91 (73%)	0.066	15 (45%)	0.055
Bilateral abnormal first rib ..	34 (27%)		18 (55%)	
Break in continuity of first rib	17	0.009	1	0.0017
Fusion or articulation of first and second ribs ..	144	0.075	63	0.105
Postfusion of ribs ..	45	0.024	6	0.01
Bifid anterior of ribs ..	182	0.095	17	0.028
Multiple rib deformities ..	7	0.0037	2	0.0033
Malformed ribs (other than first or second) ..	15	0.008	2	0.0033
Depressed sternum ..	4	0.0021	6	0.01
Vertebral malformation ..	2	0.00105	6	0.01
Diaphragmatic abnormalities	9	0.0047	4	0.0067
Azygos vein lobe ..	208	0.11	36	0.06
Infracardiac lobe ..	2	0.00105	0	0
Absence of lobe ..	11	0.0005	0	0
Dextrocardia ..	12	0.0063	4	0.0067
Congenital cardiac lesions ..	8	0.0042	10	0.017

(i) *Cervical Ribs and Abnormal First Ribs.*—It is well known that, short of a complete count of the cervical vertebræ, it may be impossible in certain cases to distinguish between a cervical rib and a first thoracic rib, especially if the condition is bilateral. For the purposes of this survey a cervical rib is considered as varying from a small element fused or articulating with the first rib to a fully formed element which may be fused or articulated with the first rib, or more commonly may present an apparently free extremity. The term "abnormal first rib" is largely self-explanatory—the abnormality consisting of departure from the normal in size and shape; its junction with the sternum follows the normal pattern. First ribs showing a break in continuity of the bone structure are considered below. It is highly probable that had time and circumstances allowed a full investigation of these abnormal first ribs, including a complete count of the cervical vertebræ, a number would have been found to be fully formed cervical ribs.

Every conceivable form of cervical rib has been met with, the most common variety in both sexes being that which completes about half of the normal arc of the first rib. The type most liable to be invisible on miniature radiographs is that of a small element projecting a short distance from the transverse process, the relatively dense shadow of the neck muscles peculiar to miniature films rendering its visualisation impossible.

The figures in the table show that while the incidence of cervical rib is almost six times as high in women as in men, the percentage of unilateral to bilateral ribs is almost identical in the sexes, unilateral cervical ribs being slightly more common (58 per cent. in men, 55 per cent. in women).

The variations from normality of the first rib are slight, the commonest

being that of a rib normal in its attachment but narrow in breadth, sometimes with a marked scalene tubercle. Incidence of all types in both sexes was found to be fairly constant, but unilateral abnormal first ribs are much more frequent in males than in females.

Symptoms ascribable to cervical ribs were found only in a very few cases, and in none were they severe enough to warrant surgical intervention.

(ii) *Break in Continuity of the First Rib.*—This curious abnormality, peculiar to the first rib, consists of an irregular bony swelling in the middle third of its length, associated with cervical rarefaction of the bone or with an irregular "joint" cavity.

The variations range from that of an irregular swelling on the medial surface of the rib with a break in continuity running a short distance laterally, to a complete division of the rib into two almost equal halves, the bony surfaces forming the break being expanded and irregular in outline.

This condition has been classed as a congenital abnormality as there is no good evidence to suggest that it is of traumatic origin. It was found to be slightly more common on the left side than the right, and in one case both first ribs presented this form of abnormality.

(iii) *Fusion or Articulation of the First and Second Ribs.*—In this condition there is a bony bridge connecting the shafts of the first and second ribs. In the majority of cases the bridge is complete, but an irregular articular cavity may be interposed. The first rib in such cases is often abnormally small, and its costal cartilage may be fused with that of the second rib.

The condition was found to be more common in women than in men and was more frequent on the right side than the left.

(iv) *Posterior Fusion of Ribs.*—This abnormality consists of a bony bridge joining the posterior 2 or 3 inches of the ribs external to the tubercles. It is peculiar in that it was nearly always found between the fifth and sixth, sixth and seventh, seventh and eighth ribs, and mostly occurs on the right side. Occasionally it extends over the posterior ends of three ribs; it may be associated with other rib deformities and hemivertebrae.

(v) *Bifid Anterior Ends of Ribs.*—Bifid anterior end of ribs was the commonest abnormality of the ribs to be found. It was more commonly present in men than in women, and it may affect any ribs, the third right rib being the commonest site.

(vi) *Multiple Rib Deformities and Vertebral Malformations.*—Deformities affecting more than one or two ribs are rare, but when they occur they are normally found to be accompanied by vertebral malformations often of the hemivertebrae type. The commonest associated abnormalities are bifid anterior ends of ribs and posterior fusion of three or more ribs.

(vii) *Marked Depressed Sternum.*—When occurring as a congenital abnormality, this condition is almost always accompanied by what at first sight appears to be a radiographically enlarged heart. Further investigation shows that the heart is displaced and rotated by the sternal depression. In such cases there is often a loud systolic murmur at the pulmonary area, accompanied by a marked second sound, probably due to the distortion and proximity of the pulmonary conus to the chest wall.

(viii) *Diaphragmatic Abnormalities.*—The abnormalities here discussed can

be divided into two types—eventration and hernia. Diaphragmatic hernia alone calls for comment. All the cases discovered were of congenital origin, and contents of the hernial sac consisted of stomach and/or large intestine. Para-oesophageal and anterior mediastinal hernia were more common than left diaphragmatic hernia. None of these patients presented any referable symptoms, and in none was surgical intervention considered necessary.

(ix) *Azygos Vein Lobe*.—The clue on the miniature film to the presence of an azygos vein lobe is the small oval shadow which is usually visible in the inner part of the first right interspace, and which represents an end-on view of the azygos vein. Miniature films will, if they are of superlative quality, reveal the whole of the fissure. The size of the lobe varied greatly, but the commonest form was that in which the lobe occupies the inner third of the apex. In the vast majority of cases its transparency has been that of normal lung tissue, but occasionally it appears more opaque. No case has been met with in which tuberculosis has been confined to the azygos vein lobe. In this series of cases the condition has been found to be almost twice as common in men as in women.

(x) *Infracardiac Lobe*.—The fine hair line characteristic of this accessory lobe cannot be seen on miniature films except in exceptional circumstances—*e.g.*, when delineated by pneumonia, tuberculosis, or bronchiectasis. Only 2 cases have been discovered in the course of this investigation, and this cannot be considered to reflect its true incidence.

(xi) *Dextrocardia and Transposition of the Viscera*.—Both types of this abnormality have been discovered—*i.e.*, some cases have presented a complete transposition of the viscera, whilst others show a minor image alone. In the latter type, other congenital cardiac abnormalities, such as patent interventricular and interauricular septum, were conspicuous by their absence, but it must be remembered that such additional lesions would be productive of physical signs in most cases leading to investigation at earlier medical examinations. The incidence in men and women has been found to be similar.

(xii) *Congenital Abnormalities of the Heart*.—These were few in number, as the majority of congenital cardiac lesions present marked physical signs, which would have led to their earlier elimination. Several cases radiographically presented enlarged hearts, but clinically there was no good evidence of abnormality. The other cases included minor degrees of patent ductus arteriosus, patent interventricular and interauricular septa.

#### AFTER-HISTORY OF PERSONNEL EXAMINED

It cannot be claimed that information is to hand concerning the after-histories of all personnel examined. The fact that an individual has been examined by mass radiography is, however, recorded on the relevant medical documents. Should such an individual subsequently be discovered to have a chest abnormality the Chest Radiography Headquarters is likely to be informed, but in some cases no doubt this has not been done. The results of this information are recorded here.

On 14 occasions it is known that the miniature film was misread at sub-

sections, because subsequent inspection of the original miniature films has revealed the presence of a lesion; 12 of these were cases of tuberculosis, 6 being ultimately diagnosed on clinical grounds and 5 by a positive sputum. The remaining tuberculous case developed a pleural effusion, the original miniature film showing a small area of infiltration which had been missed. In addition 1 case of bronchiectasis and 1 of aortic incompetence with an enlarged heart which were passed as normal have been notified.

Three cases are known in which the diagnosis made was incorrect. In 2 of these tuberculosis was diagnosed, but the lesion subsequently cleared up completely and presumably the condition was pneumonic in origin. One case was diagnosed as pulmonary fibrosis, but subsequently was found to have tubercle bacilli in the stomach washings.

Seven cases diagnosed as inactive tuberculosis were subsequently considered to be active, 5 developed a positive sputum within 4, 5, 6, 10 and 12 months of their diagnosis as inactive, and 2 developed pleural effusion in 4 months. It is considered that the subsequent history does not necessarily disprove that the lesions were inactive at the time of the examination by a Chest Radiography Subsection.

There are 12 cases subsequently diagnosed as active tuberculosis which were originally passed as normal and in which inspection of the original miniature films at a later date confirmed the original opinion. These are interesting in that they give a clue to the length of time which can be permitted to elapse between periodic mass radiography examinations. The shortest interval between the original examination and the diagnosis of active tuberculosis is 4 months. Four cases developed a positive sputum, 2 in 6 months and the others in 7 and 10 months; 5 were diagnosed on clinical grounds in 4, 5, 7, 11 and 13 months; and 3 developed pleural effusion in 4, 10 and 13 months of the original examination.

### Summary

1. The results of examination by mass miniature radiography of a quarter of a million R.A.F. and W.A.A.F. personnel followed to final diagnosis are reported.
2. Details of the organisation and technique used are outlined.
3. The total incidence of pulmonary tuberculosis was found to be 0.77 per cent. (0.28 per cent. active) in men and 0.94 per cent. (0.36 per cent. active) in women. Tuberculous cases are fully reviewed.
4. The incidence of non-tuberculous pulmonary lesions, of which the commonest is atypical pneumonia, is discussed in some detail.
5. Other conditions discovered, with special reference to congenital abnormalities, are reviewed.

### REFERENCES.

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## REVIEWS OF NEW BOOKS

*A Handbook of Roentgen Diagnosis of the Arthropathies.* By ALFRED A. DE LORIMIER. The Year Book Publishers, Inc., Chicago. Pp. 319. Price \$5.50.

This compact volume is one of a series dealing with various branches of radiology, including chest, gastro-intestinal and genito-urinary work amongst others.

The book was developed from a series of lectures given by Col. Lorimier to the U.S. Army School; throughout he has followed his lecture method of presenting an "orientation of the subject, then a catalogue of essential diagnostic roentgen criteria and finally corroborative clinical and laboratory aspects." This method has the fortunate attribute that each section and subsection is complete in itself and readily available for rapid reference.

The introductory chapter deals with the technical aspects concerned in the production of adequate pictures. Such a film should give the radiologist information about the soft tissues in the neighbourhood of joints, the regional and the articular bones, the joint space and less directly about the articular cartilages and synovial membranes. Without such information the radiologist cannot truly evaluate the film. The author rightly points out the importance of fully analysing any particular film and the folly of making a diagnosis with the aid of the visual memory alone. In all cases the radiologist should be in possession of full clinical and pathological findings and without such information he should be wary about committing himself to a diagnosis. This section is amplified by self-explanatory line drawings of the appearances of the normal joints of the body.

The peripheral joints and the joints of the spine are considered separately; further subdivisions in each group deal with developmental malformations, the osteochondropathies, the true arthritides associated with protein reactions, toxins, bacteria, etc., the group associated with mechanical stress and neoplasms, etc. A still rather formidable array of miscellaneous conditions follows this comprehensive classification.

Each condition is treated alike, giving synonyms, full radiological criteria, including corroborative radiological evidence, aetiology, incidence, clinical features and course. Each section is illustrated by self-explanatory X-ray reproductions and is followed by a comprehensive bibliography. The reproductions are in places disappointing, as so many of the finer details recorded by the author do not lend themselves to reproduction, especially on the small scale here employed. Various points of interest in the illustrations are indicated by carefully placed arrows, so that as little as possible is left in doubt.

This should prove a valuable book not only to the regular orthopaedic surgeon but to those who occasionally dabble in the arthropathies. Its arrangement lends itself to rapid consultation and the associated clinical aspects help considerably to give the reader a glimpse of the whole condition at one time.

*Chest Surgery for Nurses.* By J. LEIGH COLLIS and SISTER MABBIT. Baillière, Tindall and Cox, London. Pp. 128. Price 7s. 6d.

This small book has been prepared by a thoracic surgeon and an active nursing sister with considerable experience in both the practical as well as the educational side of chest nursing.

The book is intended to outline the various pathological conditions en-

countered in the chest, together with methods and rationale of treatment. Little mention has been made of the particular nursing problems encountered; in the reviewer's opinion it would have appeared advantageous to include this aspect, which would have enhanced the value of the book considerably.

The opening section of the book is devoted to the anatomy and physiology of the thorax; the subject is dealt with simply and clearly, being illustrated by simple line drawings.

There follows an all too short chapter on general clinical principles dealing with such questions as oxygen administration, charts, physical signs, etc. It is this section which could well be elaborated to give guidance to the nurse in the intelligent performance of her task. The fundamentals of breathing exercises might well be included, as tuition and supervision often lie with the nurse; the mechanism of coughing (not mentioned in the section on physiology) and its successful performance under disadvantageous circumstances is also surely worthy of mention; the manner in which one copes with the functionless drainage tube is a problem which both nurse and surgeon are constantly faced with and one which here receives insufficient attention.

Diseases of the chest wall, pleura, lungs, mediastinal contents and diaphragm are then ably discussed from the point of view of pathology, clinical features and treatment. Here again the authors describe lucidly and simply the various aspects of the conditions considered. The rationale of treatment employed, the essential details of technique and the instruments usually employed are all outlined and illustrated by line drawings and diagrams.

The book concludes with an X-ray supplement comprising 14 plates and simple explanatory diagrams.

The text is, on the whole, clear and straightforward. The material is well set out and paragraph headings are wisely employed. The book should prove immensely valuable not only to the growing number of regular theatre and ward chest nurses, but in addition to that far greater number who, though not in a chest unit, have not infrequently the difficult task of nursing a chest case.

*Lungenröntgenbilder.* By RUDOLF ZEERLEDER. Hans Huber, Bern, 1943. Price fr. 13.50.

This short volume in German is nicely produced and gives in condensed form the differential diagnosis of the chief abnormal radiological appearances in the lung fields with brief case notes and some finely done reproductions of X-rays. It is really a small atlas, but it covers the rarities as well as the common diseases, and also has the praiseworthy feature of a high proportion of necropsy verifications to recommend it. Also a few references are well chosen to lead to further study for those who wish to do so, excepting that they are taken almost exclusively from the French and German literature.

*Brompton Hospital Reports*, Vol. XII, 1943. Published by the Research Department of the Hospital. Pp. 163. Price 8s.

A volume of these familiar reports is always welcome. This is no exception. As is usual, this edition consists of papers recently published from the Hospital, most of which have already appeared in the literature, some in previous issues of this JOURNAL. This collection forms a useful indication of some recent trends in diseases of the chest.

Dr. Margaret McPherson presents a summary of the work and results of the Hospital's Research Department's investigation into the problem of child-

hood infection and its relation to adolescent and adult pulmonary tuberculosis. This investigation was instigated in 1928, so that here some fourteen years' work is correlated. A short summary is given of each of seven papers published by different workers from the Department over this period. Arising out of these investigations, the conclusions of which repay study, attention has been focused on the treatment of the young adult with the symptomless closed lesion. A plea is made for the employment of a shallow pneumothorax in this type of case. In view of the problem these cases are presenting at the moment, and will present in the future with the greater use of mass radiography, we look forward with interest to a later report on the results of this measure, as it is emphasised that it is as yet impossible to assess its efficacy. Dr. Wingfield also, in a short yet forceful paper, urges the importance of finding and treating the young adult in the symptomless closed stage rather than attacking the problem piecemeal by endeavouring to render the sputum-positive case negative.

Undoubtedly the outstanding article in this volume is contributed by Mr. Price Thomas and Mr. Cleland—a detailed, well-illustrated paper describing the operation of extrafascial apicolysis with thoracoplasty. The indications, technique and complications of the operation are exhaustively and clearly discussed and followed by a short article detailing the results of thoracoplasty in a series of 120 personal cases.

Mr. Brock, writing on "The Treatment of Tuberculous Empyema," presents a reasoned argument for active treatment supported by convincing figures from his own series of cases. This paper appears to have been in part stimulated by the plea of the late Dr. Chandler for a conservative approach. Mr. Brock supplies an adequate and necessary reply.

The reprinting here of a recent article by Mr. Tudor Edwards on "Traumatic Hæmothorax" is timely. It deals with the treatment and prognosis of simple hæmothorax and repays careful attention.

Surgeon-Captain Brooks presents a survey of miniature radiography as applied to 167,000 naval ratings. As is to be expected, pulmonary tuberculosis was by far the commonest lesion disclosed. Comment is made on the difficulty in disposal of cases showing apparently inactive lesions.

Several other papers complete this volume, which undoubtedly contains much of value to all interested in diseases of the chest, and, moreover, is moderately priced.

*Notable Names in Medicine and Surgery.* By HAMILTON BAILEY and W. J. BISHOP. H. K. Lewis and Co., Ltd. 15s.

In these days of increasing precision in medical terminology, many of the familiar names of former times are going out of everyday use. Thus the great name of Bright disappears among the nephritides and Dover's piratehood is forgotten in "Pulv. Ipecac. Co." The authors of this book have taken some eighty of the names in common use, whether associated with diseases, operations, signs or other medical procedures, and given us a short biography of each man or woman concerned. As well as the major facts of their lives a number of charming or amusing anecdotes are included which make these figures spring very much alive. Gas gangrene gains an unearned attraction when one learns that Welch was known throughout America as "Popsy," and surely it would soften the heart of any examiner, questioning the faltering student about Syme, to hear that he discovered, but failed to patent, the rubber solution which made a fortune for Macintosh.

It appears that even for the surgeon who started operating at dawn life was less wearing in earlier centuries than in this. An astonishing number of the men and women in this book lived to great ages; over a third exceeded 75, and ten lived to 85 or more—a sad comparison with the modern doctor's expectation of life.

In compiling a book as small as this the task of selection from the wealth of possible material must be extremely difficult, and here the authors have not been entirely successful. It would be easy, and foolish, to search among the wide fields of medical usage and complain of the absence of personal favourites, but the authors' description of these as selected biographies protects them from such carping criticism. Nevertheless the hand of the surgeon lies rather heavily on this selection, and, particularly in comparison with the large number of surgical instruments included, medicine is rather inadequately represented. The inventors of Doyen's raspator, Potain's aspirator, and Gooch's splint would not be grudging their place if it were not for the surprising absence of such names as Sydenham, Osler, Babinski and Parkinson, whose discoveries and lives were surely of great significance. It is not easy to discover what criteria have had to be satisfied before a candidate for biography could be accepted, and the resulting unbalance detracts considerably from one's pleasure in the book. It is unfortunate, too, that in the need for brevity a few statements too sweeping for accuracy have been admitted, so that the Wassermann reaction has been described as "deadly accurate" and splenectomy called the only cure for Banti's disease.

It is always interesting to speculate on the appearance of the great, and this curiosity is well satisfied here, for each biography is headed with a portrait. There are many other delightful and unusual illustrations; a number show famous hospitals as they were years ago, and many of the conditions or inventions described are illustrated by photographs or simple diagrams. The profusion and excellent reproduction of the illustrations probably accounts for the rather high price of 15s. This is a book with which one may amuse an idle hour, but it is not adequate as—nor is it meant to be—a reference book.

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## NOTICE

### GOVERNMENT WHITE PAPER: "A NATIONAL HEALTH SERVICE"

*Resolutions adopted by the Joint Tuberculosis Council, Thursday,  
July 20, 1944*

(a) Regarding para. 1, page 40, lines 2-10: "That the Tuberculosis Officer should have beds under his direct control, preferably in a Local General Hospital, which would be available for differential diagnosis and assessment of his cases. It would not be in the interests of the adequate institutional treatment of patients that existing sanatorium beds should be divided among the visiting Tuberculosis Officers as proposed in the White Paper."

(b) The Joint Tuberculosis Council by virtue of its long experience of the problems of tuberculosis should be consulted on any proposed new measures arising out of the White Paper affecting the prevention, diagnosis and treatment of the disease.





WILFRED HADLEY.

*To face page 145*

(c) That the Tuberculosis Service should be represented by persons nominated by the Joint Tuberculosis Council on the Central Health Services Council which, in the words of the report, "is to be able to express the expert view on any general technical aspect of the service."

(d) That in the opinion of the Joint Tuberculosis Council, tuberculosis in all its aspects should be treated as one specialty by the Tuberculosis Service, the senior officers of which should have the status of consultant.

(e) That Clinical Tuberculosis Officers and Medical Superintendents of Tuberculosis Institutions should be directly represented on the Local Health Services Council and that such representatives should have the right of approach to Joint Boards and their appropriate committees.

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## OBITUARY

### WILFRED HADLEY

WILFRED HADLEY was born at Gloucester, and in October 1879 at the age of seventeen entered the London Hospital Medical College. Sir Andrew Clark was then senior physician, the other physicians being Langdon Down, Hughlings Jackson, Sutton and Samuel Fenwick. The surgeons were Jonathan Hutchinson, Cooper, Rivington and Adams.

Hadley qualified L.S.A. and M.R.C.S. in 1883. In 1884 he was house surgeon to Rivington and in 1885 house physician to Sir Andrew Clark, who recognised his ability and recommended him to seek academic honours. In 1886 he gained the first place in the honours list at the M.B. examination at Durham University, and was awarded the Gold Medal when he proceeded M.D. in 1893. Returning to the London he was appointed resident accoucheur under Dr. Herman in 1887, and in the same year became F.R.C.S. Eng. In 1890 he passed the M.R.C.P. examination and was appointed pathologist to the Victoria Park Chest Hospital and in the following year assistant physician, becoming a full physician in 1903 and consulting physician on his retirement in 1925. In 1892 he was appointed medical registrar at the London Hospital and in 1893 assistant physician, the vacancy being due to the early death of James Anderson. In 1892 he had obtained the D.P.H. at Cambridge.

Other academic honours were the M.D. Durham in 1893 and the F.R.C.P. Lond. in 1899.

At the London he became full physician in 1904 and consulting physician on his retirement in 1924. Apart from clinical teaching, Hadley's interests at the London were chiefly devoted to morbid anatomy and pathology, of which subjects he was a demonstrator from 1894 until 1920. He was lecturer on bacteriology and pathological histology from 1894 to 1897, when the reorganisation of the Medical College introduced William Bulloch as the bacteriologist and lecturer on the subject.

Hadley continued to lecture on medical pathology until 1904, when he became lecturer on medicine and held that office until his retirement.

His experience in morbid anatomy and its relation to clinical phenomena added great value to the opinions expressed in the work on fibroid diseases of the lung which he produced in collaboration with Andrew Clark and Arnold Chaplin.

I met Hadley for the first time in 1895 when I entered the London Hospital as a student. He was then lecturer on bacteriology and pathological histology, but the laboratory equipment was still in embryo and the practical instruction was elementary. Ainley Walker and I were appointed by him as voluntary demonstrators and as such were allowed a key of the laboratory so that we could work there in our spare time. Ainley Walker at least benefited by his kindly action, which laid the foundation for his subsequent work at Oxford.

Keen as he was on the academic aspect of his profession, Hadley's main interest lay in the study and teaching of clinical medicine. He attached much importance to and gained an enviable reputation for his attention to the practical details of treatment, thus handing on the tradition he had received from Sir Andrew Clark. Much of this he embodied in his book on general medical and surgical nursing, which he published in 1901. His long association with the Victoria Park Hospital gave a solid foundation for his reputation as a specialist in diseases of the lungs, but the days of the pure specialist and of the pure consultant had not yet arrived, and much of his private practice dealt with general medicine and often he became the personal friend as well as the medical adviser of his patients.

I found him always kind and helpful both in private and professional problems. He married the daughter of H. T. Wells, R.A., who was the widow of Ernest Charrington and had one daughter, now Mrs. M. C. N. Jackson, who was a student first at University College and later for the clinical period at the London and is now in practice at Crediton with her husband.

Throughout his life he was always fond of sport. After his retirement he went to live at Reigate and seldom came to London.

He died at Reigate on July 6, aged eighty-two.

CECIL WALL.

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**Subjects:** The National and Public Health Problem; early diagnosis; modern methods of treatment; pathological methods; surgery; psychological considerations; rehabilitation; social legislation; etc.

**Visits to:** Alder Hey, Fazakerley, Leasowe, and other institutions.

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#### CARDIFF

April 18-21, 1944, 9.30-5.30, at the Welsh  
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**Lecturers will include:** Mr. N. R. Barrett, Professor T. W. Davies, Dr. S. H. Graham, Dr. J. C. Gilchrist, Dr. A. D. R. Lapp, Professor K. M. F. Picken, Dr. N. Tattersall, Dr. Dillwyn M. E. Thomas, Professor W. H. Tytler, Dr. A. G. Watkins.

**Subjects:** The National Problem; dispensary organisation, diagnosis, and assessment for treatment; mass radiography; hospital organisation and treatment; complications; bacteriological findings; thoracic surgery; relation of the tuberculosis service to the practitioner and the public health services; etc.

The Course will be held at the Cardiff Tuberculosis Dispensary and at Sully Hospital, as well as at the School of Medicine.

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Numbers will be strictly limited, and early application should therefore be made to  
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